OPTION — NOT USED ON VB2

REMEX

(READER ONLY — NO SPOOLER ASSEMBLY)

Peripheral Products

Ex-Cell-O Corporation

TECHNICAL MANUAL

TAPE READER

MODEL: RR-7155BA1/660

IMPORTANT INFORMATION

Changes to the equipment which are made between manual printings are listed in an addendum at the rear of the manual. As a convenience, a list of change pages is given as the last page in the manual. It is recommended that each of these pages be marked "Refer to Addendum" so that these changes can be identified.

EX-CELL-O CORPORATION
REMEX
1733 Alton St. • P.O. Box C-19533 • Irvine, CA 92713

Copyright 1980© by REMEX, a Unit of Ex-Cell-O Corporation. Printed in the United States of America. All rights reserved. This book or parts thereof may not be reproduced in any form without permission of the publishers.

WARRANTY

The following section is part of the Standard Terms and Conditions and covers only the Warranty. The reader should refer to the complete Standard Terms and Conditions for the entire sales agreement.

The Seller warrants to the original Buyer only, that the Product, except as to software and firmware, is free from defects in workmanship and material under normal use and service. The Seller's obligation under this warranty shall be limited to furnishing a replacement for, or at the Seller's option repairing any Product or any part or parts thereof, which prove defective within 90 days* from the date of shipment by the Seller, provided such Product or such part or parts are returned to the Seller transportation prepaid.

The Seller warrants, for a period of thirty (30) days from the date of shipment by the Seller to the original Buyer only, that the software and firmware Products are free from defects in workmanship and material. Seller's obligation under this warranty shall be limited to correcting any of said defects or replacing the software or firmware. Said warranty shall be void and of no effect whatsoever in the event that changes or additions have been made to the software or firmware (or in the event that the software or firmware product has been adapted by the Buyer) to serve a function not within the system specifications of the Seller.

All replacement Products or parts thereof furnished under this warranty will be invoiced in the usual manner and adjustments will be made after the Product or part thereof claimed to be defective has been returned to, and inspected at, the Seller's plant. Replacements shall be furnished under this warranty F.O.B. Buyer's plant, and the Seller shall not be responsible for installation costs. (For all international transactions, replacement shall be furnished F.O.B. Port of Entry and Buyer is responsible for all customs and brokerage fees.) The Buyer shall be liable for all freight inspection and handling costs if such Product or such part or parts do not prove to be defective. In no event will any claim for labor in removing or replacing a defective Product or part for incidental or consequential damages be allowed. No warranty is made as to any Product or part which has not been installed, operated, or maintained in accordance with Seller's instructions or the instructions contained in its operations or maintenance manuals, when furnished by the Seller, or which has been subject to misuse, abuse, accident, or alteration or to improper or negligent use, maintenance, storage, transportation or handling.

This warranty is in lieu of all other warranties expresses or implied, including any warranty of merchantability or fitness for a particular purpose, and the Seller neither assumes, nor authorizes any person or firm to assume for it, any other or further obligation or liability in connection with the sales, installation or use of any product.

UNDER NO CIRCUMSTANCES SHALL SELLER OR ANY AFFILIATE OF SELLER HAVE ANY LIABILITY WHATSOEVER FOR LOSS OF USE OR FOR ANY INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

*All paper tape products are covered under this warranty for a period of one year, excepting punch mechanisms, lamps and fuses which are warranted for a period of 90 days. Flexible disk drives are warranted for a period of 180 days.

FOR YOUR SAFETY

Before undertaking any maintenance procedure, whether it be a specific trouble-shooting or maintenance procedure described herein or an exploratory procedure aimed at determining whether there has been a malfunction, read the applicable section of this manual and note carefully the **WARNING** and **CAUTION** contained therein.

The equipment described in this manual contains voltages hazardous to human life and safety and may contain mechanical components capable of inflicting personal injury. The cautionary and warning notes are included in this manual to alert operator and maintenance personnel to the electrical and mechanical hazards and thus prevent personal injury and damage to equipment.

TABLE OF CONTENTS

Section	Title	Page
I	GENERAL DESCRIPTION	1-1
1.1	EQUIPMENT DESCRIPTION	1-1
1.2	EQUIPMENT SUPPLIED	1-1
1.3	MAINTENANCE EQUIPMENT REQUIRED BUT NOT SUPPLIED	1-1
1.4	EQUIPMENT WARRANTY	1-1
1.5	SPECIFICATIONS	1-2
1.6	MODEL NUMBER DESIGNATION	1-2
1.7	PHYSICAL DESCRIPTION	1-5
1.8	TAPE CHANNEL NUMBERING	1-8
II	INSTALLATION AND INTERFACE	2-1
2.1	UNPACKING	2-1
2.2	MOUNTING	2-1
2.3	INITIAL ADJUSTMENTS	2-1
2.4	POWER AND SYSTEM CONNECTIONS	2-1
2.4.1	TRANSFORMER WIRING CHANGE FOR VOLTAGES OTHER THAN 115 VAC	2-3
2.5	INTERFACE CIRCUITRY	2-3
III	OPERATION	3-1
3.1	INPUT-OUTPUT SIGNALS	3-1
3.2	CONTROL FUNCTIONS	3-1
3.3	OPERATING INSTRUCTIONS	3-1
3.3.1	LOADING INSTRUCTIONS	3-1
3.3.2	TAPE DRIVE, READ MODE	3-3
3.3.3	TAPE DRIVE, WIND MODE	3-5
3.3.4	EXTERNAL INHIBIT	3-5
3.3.5	MANUAL DRIVE MODE OPERATION	3-6
3.3.6	DATA OUTPUT MODE SELECTION	3-6
3.4	OPERATIONAL MAINTENANCE	3-6
3.5	TAPE RECOMMENDATIONS AND AVAILABILITY	3-7
3.6	TAPE PREPARATION REQUIREMENTS	3-7

TABLE OF CONTENTS
(CONTINUED)

Section	Title	Page
IV	THEORY OF OPERATION	4-1
4.1	BLOCK DIAGRAM DESCRIPTION	4-1
4.1.1	TAPE DRIVE	4-1
4.1.2	TAPE READING	4-3/4-4
4.2	CIRCUIT CARD DESCRIPTIONS	4-3/4-4
4.2.1	READER CIRCUITRY	4-7
4.2.1.1	Drive Circuits	4-7
4.2.1.2	Wind Mode Operation	4-9
4.2.1.3	Inhibit Mode	4-10
4.2.1.4	Tape Reading Circuits	4-10
4.2.2	POWER SUPPLY	4-11/4-12
V	MAINTENANCE	5-1
5.1	GENERAL	5-1
5.2	PREVENTIVE MAINTENANCE	5-1
5.2.1	CLEANING	5-2
5.2.1.1	Readhead Assembly Cleaning	5-4
5.2.1.2	Sprocket Cleaning	5-4
5.2.1.3	Tape Inspection	5-4
5.2.1.4	General Cleaning	5-4
5.2.2	LUBRICATION	5-4
5.2.3	POWER SUPPLY VOLTAGES	5-5
5.3	TROUBLE SHOOTING	5-5
5.4	READER ALIGNMENT	5-8
5.5	TAPE SPLICING	5-14
VI	PARTS REPLACEMENT	6-1
6.1	GENERAL	6-1
6.2	READER PARTS REPLACEMENT	6-1
6.2.1	READHEAD MECHANISM DISASSEMBLY	6-1
6.2.2	READER CARD REPLACEMENT	6-2
6.2.3	MOTOR AND/OR SPROCKET REPLACEMENT	6-3
6.2.4	TRANSFORMER REPLACEMENT	6-3
6.2.5	FRONT PANEL AND CHASSIS SEPARATION	6-4
VII	PARTS LIST	7-1
7.1	GENERAL	7-1

TABLE OF CONTENTS
(CONTINUED)

Section	Title	Page
VII	GENERAL	7-1
7.2	KIT OF PARTS	7-1
VIII	SCHEMATIC DRAWINGS	8-1/8-2

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	REMEX Reader RR-7155BA1/660 and RR-7155BA1/660, with Fanfold Option	1-3
1-2	Model Number Coding for RR-7155BA1	1-6
1-3	Installation Drawing, Model RR-7155BA1/660, with Fanfold Option as shown	1-7
1-4	Tape Channel Numbering and Dimensions	1-8
2-1	Reader Connections to External Equipemnt	2-2
2-2	Recommended Interface Circuitry	2-4
3-1	Timing Diagram for RR-7155	3-2
3-2	Tape Loading RR-7155BA1/660	3-4
4-1	Block Diagram Reader Circuitry	4-2
4-2	Timing Diagram, Reader Circuit Card	4-5/4-6
5-1	Proper Methos of Inserting Cleaning Brush	5-5
5-2	Sprocket Height Adjustment Technique	5-9
5-3	Sprocket to Readhead Clearance	5-9
5-4	Alignment of the Sprocket with the Light Columns	5-13
5-5	Adjustment of the Upper Tape Guide	5-13
5-6	Tape Splicing Procedure	5-16
7-1	Readhead Mechanism and Step Motor Assembly, Exploded View	7-9/7-10
7-2	Top View, RR-7155BA1, Showing Chassis Assembly	7-11
7-3	Rear View, RR-7155BA1	7-12
7-4	Front View, RR-7155BA1	7-13/7-14
8-1	System Schematic, RR-7155BA1	8-3/8-4
8-2	Schematic, Reader Card 114321-00X	8-5/8-6

LIST OF TABLES

Table	Title	Page
1-1	Items Included with the RR-7155BA1	1-2
1-2	Specifications of the REMEX Reader, Model RR-7155BA1	1-4
1-3	Options Used with RR-7155BA1	1-5
3-1	Interface Signal Descriptions	3-7
3-2	Front Panel Controls	3-9
3-3	Modes of Operation	3-9
3-4	Recommended Tapes	3-10
5-1	Maintenance Equipment Required	5-1
5-2	Preventive Maintenance Schedule and Log	5-3
5-3	Power Supply Voltage Locations and Specifications . .	5-5
5-4	Trouble Shooting	5-6
6-1	Transformer Wire Connections	6-4
7-1	Recommended Spare Parts, RR-7155BA1	7-2
7-2	Parts List, RR-7155BA1	7-3
7-3	Parts List, Printed Circuit Card Assembly, 114321-003, -004	7-5

SECTION I

GENERAL DESCRIPTION

1.1 EQUIPMENT DESCRIPTION

This manual has been prepared to assist the user in interfacing, installing, operating and maintaining the REMEX Model RR-7155BA1/660 series Punched Tape Reader. See Figure 1-1. Figure 1-2 gives an explanation of the model number designation. It is the purpose of this model series to provide tape reading at up to 200 characters/second speed. Although the applications for punched tape readers are many and varied, they are generally used as input devices for digital computers, communication systems, numerical controls, and system checkout equipment.

The printed circuit card provides the logic control for tape movement in either direction from external signals. The output from the card controls a step motor which drives the tape via a sprocket wheel. Data outputs are generated from the photosensor array in the readhead. As tape passes over the readhead, changes in light intensity are sensed by the phototransistors, amplified, and brought out to an external connector.

1.2 EQUIPMENT SUPPLIED

Several items are included with the reader for spare parts, installation, and maintenance. These items are listed in Table 1-1. No other equipment is required for the operation of the unit.

1.3 MAINTENANCE EQUIPMENT REQUIRED BUT NOT SUPPLIED

The maintenance procedures in Section 5 require equipment that is not supplied. This equipment is listed in Table 5-1.

1.4 EQUIPMENT WARRANTY

A statement covering the warranty of this equipment is given on page iii (second page in book). It should be read and understood. All preventive maintenance procedures must be performed as outlined in Section 5.2 during the warranty period in order that the warranty should remain in effect. Any questions arising concerning the warranty should be directed to the REMEX Service Department.

Table 1-1. Items Included with the RR-7155BA1.

Item	REMEX Part No.	Quantity
Brush, Readhead Cleaning	107466-000	1
Fuse, 1A, Slow Blow (100, 115, 127 VAC Operation)	705710-118	1
Fuse, 1/2A, Slow Blow (220, 230 or 240 VAC Operation)	705716-002	1
Fuse Carrier, Black (F101), 230 VAC only	705750-122	1
Fuse Carrier, Gray (F101), 115VAC only	705750-121	1
Power Cord, Belden 17250	708000-110	1

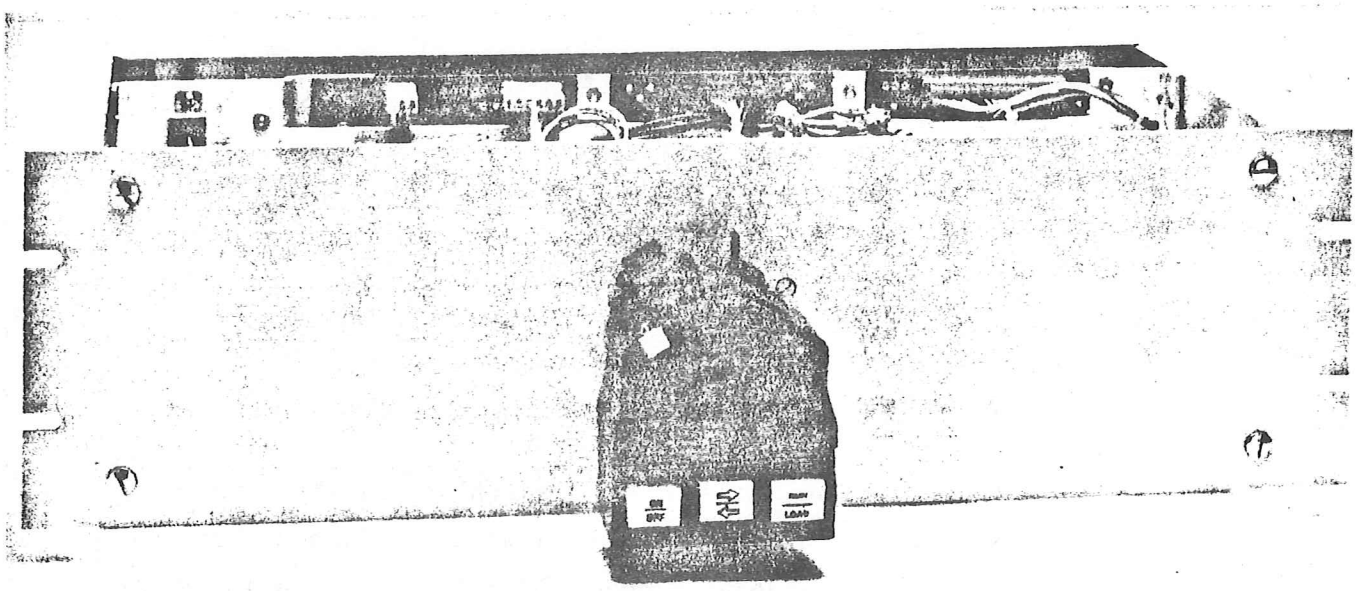
1.5 SPECIFICATIONS

The specifications for the REMEX Reader are listed in Table 1-2.

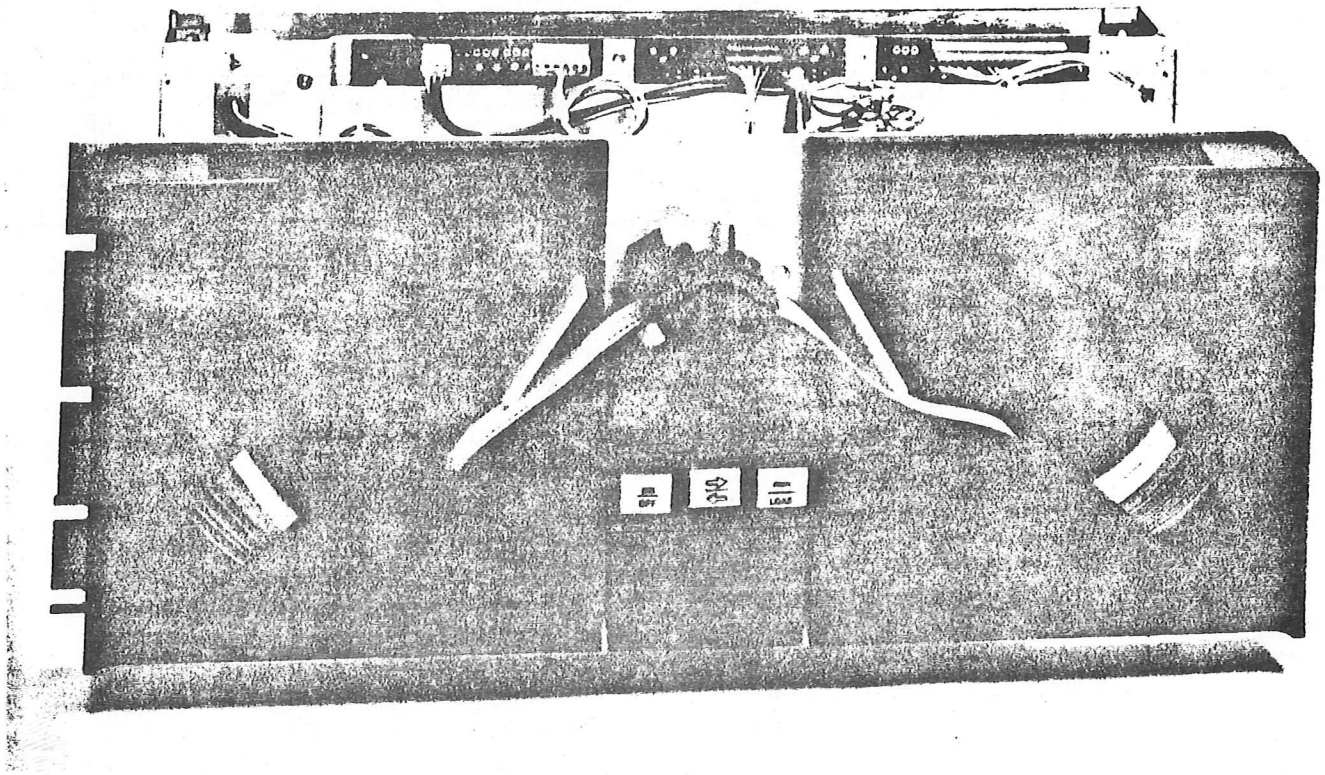
1.6 MODEL NUMBER DESIGNATION

The REMEX model designation is used to code the basic functions and configurations of a particular product line. The model number codes for the RR-7155 series are shown in Figure 1-2. An X in a particular digit designator (as used in many parts of this manual, especially in the parts list) denotes any of the combinations for that digit given in Figure 1-2 applies in the instance cited. The serial tag is located on one of the rear surfaces. In all correspondence, always refer to the complete model number, including the mode and the special number and the unit's serial number.

The last three digits of the model number denote either a standard unit (000 or 901 and higher) or a special (all other numbers). Units with 000 indicate standard units with no additional options other than those coded in the model number structure. Units with 901 and higher are used to indicate the number of standard options (used only on standard units) which are not coded in the model number. These are listed on the serial tag below the model number in the form of a series of three digit numbers depending upon the number of options used. For example, a unit with 902 would list two three digit numbers. Table 1-3 lists the options used with the RR-7155BA1.



Model RR-7155BA1/660



Model RR-7155BA1/660 With Fanfold Option

Figure 1-1. REMEX Reader RR-7155BA1/660 and RR-7155BA1/660 with Fanfold Option.

Table 1-2. Specifications of the REMEX Reader, Model RR-7155BA1.

Characteristic	Specification
Tape Movement	Bidirectional (left-to-right or right-to-left).
Reading Speed	Asynchronous: 0-200 characters/second. Synchronous Mode: 200 characters/second/ See Sections 3.3.2 and 3.3.3.
Tapes	Reads standard 8-track (1-inch) tapes with light transmissivity of 57% or less and thickness between 0.0027 and 0.0045 inch (oil buff paper tape). Tapes must be punched as described in Section 3.6.
Input Power	115 or 230 VAC (switch on the rear panel allows selection of either voltage), 47 to 63 Hz, single phase at 1 Amp (115VAC) or 1/2 Amp (230 VAC).
Temperature	Operating: $0^{o}C$ to $65^{o}C$, Free Air Non-operating: $-55^{o}C$ to $85^{o}C$
Weight	14.2 lbs.
Mounting Dimensions	RR-7155BA1/660, 5.25" high, 19" wide, 8" behind a 1/8" panel. Allow 3 inches at rear for cabling. See Figure 1-3.
Mode of Operation	Low Speed. See Sections 3.3.2.
Data Output	Data Mode Selectable (See Section 3.3.6). Mode 5: Hole: $+2.4 < V < +5.0$ @ 0.2 mA (source) No hole: $0 < V < +0.4$ @ 16 mA (sink) Mode 6: Hole: $0 < V < +0.4$ @ 16 mA (sink) No hole: $+2.4 < V < +5.0$ @ 0.2 mA (source)
Timing	Timing Diagram given in Figure 3-1.

Table 1-3. Options Used with RR-7155BA1.

Option No.	Description	Change Required
002	Step Motor Power Down.	Replace P.C. Card 114321-001 with 114321-004.

1.7 PHYSICAL DESCRIPTION

The REMEX Tape Reader is mounted on a 19-inch panel with a height of 5.25 inches. The fanfold option adds an additional 1.75 inches of panel height. Detailed dimensions are shown in Figure 1-3. The front panel contains the tape reading and transport mechanism. The electronic chassis is mounted at the rear of the unit and extends approximately 8 inches behind the front panel.

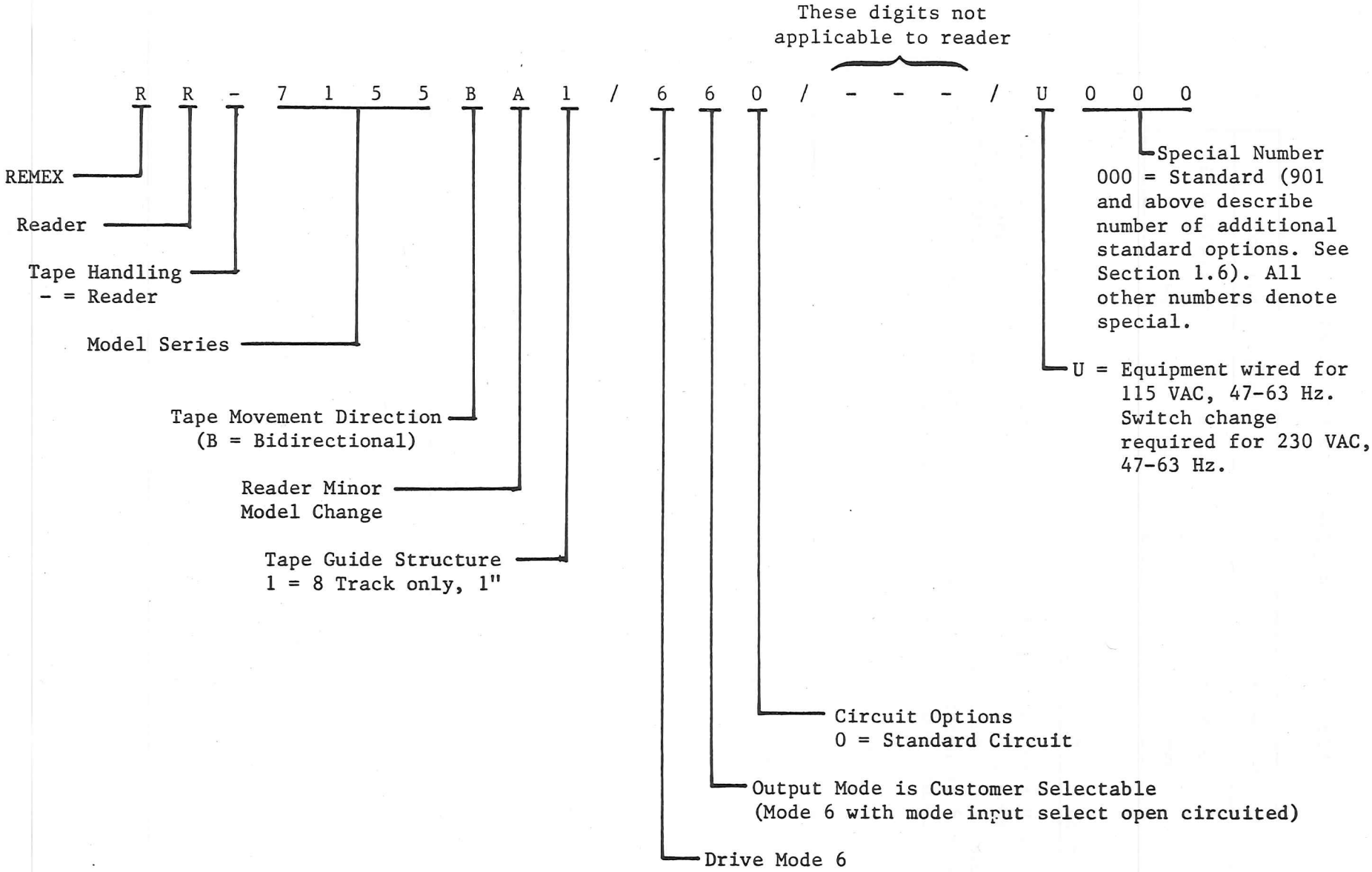


Figure 1-2. Model Number Coding For RR-7155BA1.

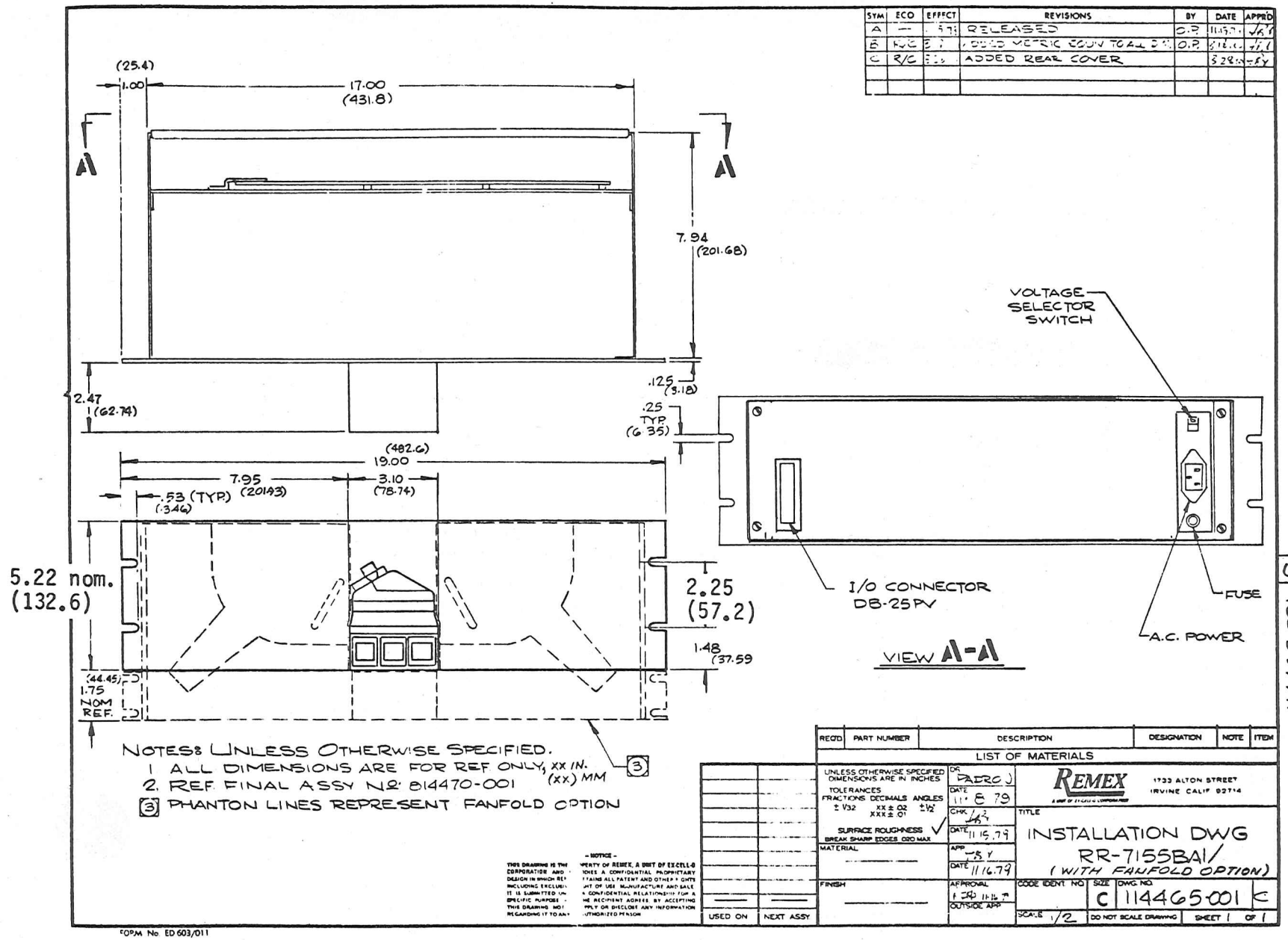
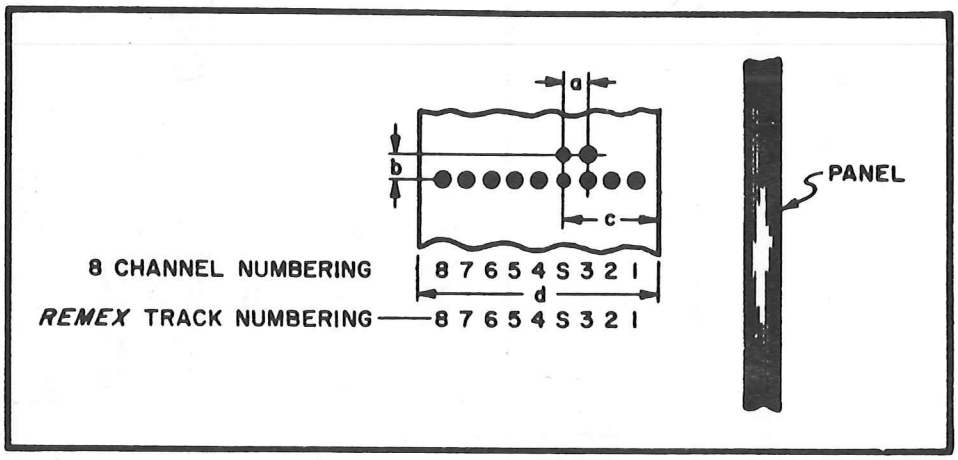


Figure 1-3. Installation Drawing, Model RR-7155BA1/660 with fanfold option also shown.

1.8 TAPE CHANNEL NUMBERING

Figure 1-4 illustrates the tape channel numbering. The reader accepts one inch, eight channel tape only.



MMC 285

a = 0.100 ± 0.002

b = 0.100 ± 0.003

c = 0.392 ± 0.004

d = 1.000 ± 0.003

Tolerance: In span of 1-inch is ± 0.010
In span of 5-inches is ± 0.025

Data Hole Diameter = 0.072 ± .002

Sprocket Hole Diameter = $0.046 \begin{smallmatrix} +.002 \\ -.001 \end{smallmatrix}$

Figure 1-4. Tape Channel Numbering and Dimensions.

SECTION II

INSTALLATION AND INTERFACE

2.1 UNPACKING

To provide the most protection during transit, specially designed and reinforced packing cartons are used to ship the REMEX punched tape reader. Those items listed in Table 1-1 are also packed with the unit. When removing the unit from the carton, the reader should be lifted with both hands under it. Never lift or attempt to carry the unit by any of the covers, drive assembly, or other delicate parts. Carefully inspect the unit for any apparent damage as soon as it is removed from the carton. Check the equipment supplied list in Table 1-1 against the kit of parts supplied with the reader. In the event the equipment has been damaged as a result of shipping, the carrier and REMEX must be notified as soon as possible.

2.2 MOUNTING

The unit mounts in a standard 19-inch rack with mounting holes provided. To ensure a minimum transmission of accoustical noise and vibration to other equipment, the reader should be securely mounted. When mounting the unit in a closed cabinet, adequate air circulation should be supplied so that the unit does not exceed the ambient temperature specification listed in Table 1-2.

2.3 INITIAL ADJUSTMENTS

Each reader has been accurately adjusted and aligned before leaving the factory. No adjustment or calibration should be required prior to installation or use. However, the proper fuse from the kit of parts requires installation and the voltage switch at the rear of the unit requires switching to the desired voltage input. Refer to Section 2.4.

2.4 POWER AND SYSTEM CONNECTIONS

Input AC power (refer to Table 1-2) is applied through the A.C. Connector at the rear.

CAUTION

All units come wired for 115 or 230 VAC, 47-63 Hz operation. The proper input voltage must be selected

as described in Section 2.4.1. In addition, before operating the system, the proper fuse value (as indicated in Table 1-1) must be inserted from the kit of parts. Discard the other fuse (unless, of course, a different voltage operation is anticipated).

All control signals and data track output signals are routed through J1. Figure 2-1 lists the detail routing of these signals and their description is given in Table 3-1. All wire sizes are 22 AWG unless otherwise noted in Figure 2-1. The proper mating connector for J1 has been supplied with the unit.

NOTE: All input and output signals are defined for positive logic, mode 5, i.e., logic 0 = 0V and logic 1 = + 5V. Therefore, signals that are mode 6, 0V true for logic 1 (action condition) are written with a bar over the designation, e.g., $\overline{\text{Drive Right}}$ Input.

J1

1	Data Track 1 Output
2	Data Track 2 Output
3	Data Track 3 Output
4	Data Track 4 Output
5	Data Track 5 Output
6	Data Track 6 Output
7	Data Track 7 Output
8	Data Track 8 Output
9	Data Ready Output
10	Data Mode Select Input
11,12,13,24 — 20 AWG	Signal Ground 0V
14	$\overline{\text{System Ready}}$ ($\overline{\text{SYSRDY}}$) Output
15	$\overline{\text{External Inhibit}}$ ($\overline{\text{EXT INH}}$) Input
16	$\overline{\text{Drive Right}}$ ($\overline{\text{DR}}$) Input
17	$\overline{\text{Drive Left}}$ ($\overline{\text{DL}}$) Input
18	$\overline{\text{Wind Enable}}$
19	+ 12 Vdc @ 100 mA
20	$\overline{\text{Wind Right}}$ ①
21	$\overline{\text{Wind Left}}$ ①
22	- 12 Vdc @ 100 mA
23	+ 5 Vdc @ 0.5 mA
25	Chassis Ground

① These inputs not present on earlier units.

Figure 2-1. Reader Connections to External Equipment.

See Table 3-1 for Signal Descriptions.

2.4.1 TRANSFORMER WIRING CHANGE FOR VOLTAGES OTHER THAN 115 VAC

All units come from the factory with a transformer which allows any of two input voltages to be used: 115 VAC or 230 VAC, 47-63 Hz. Unless otherwise directed by the customer, all units leave the factory wired for 115 VAC. If it becomes necessary to operate on the other voltage, a simple switch change is required.

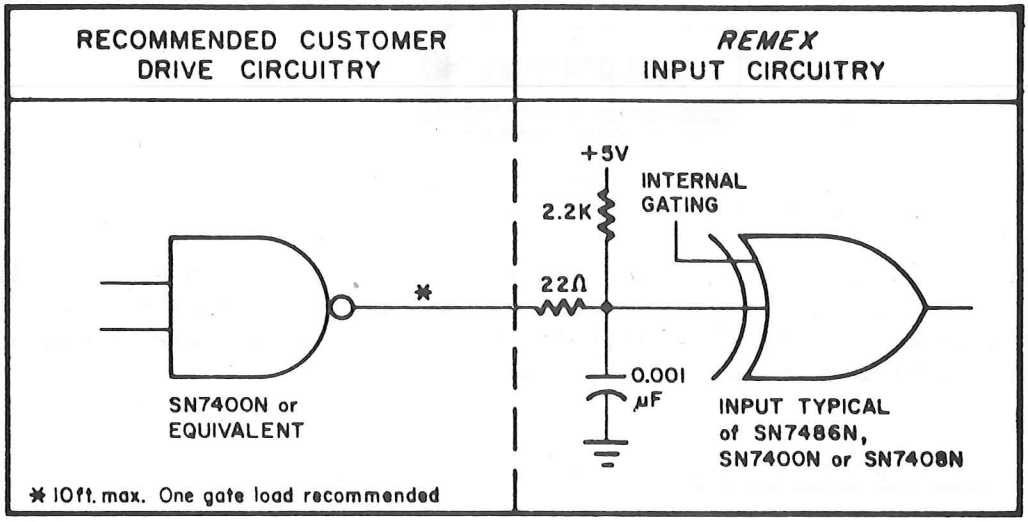
Make sure the power plug is disconnected before making the change.

Change switch S104 from 115 to 230. Switch S104 is located on back anel. See Figure 7-4. In addition, a 1/2 amp fuse and the black fuse carrier from the kit of parts must be substituted for the 1 amp fuse and the gray fuse carrier at F101 when using 220 or 240 VAC.

2.5 INTERFACE CIRCUITRY

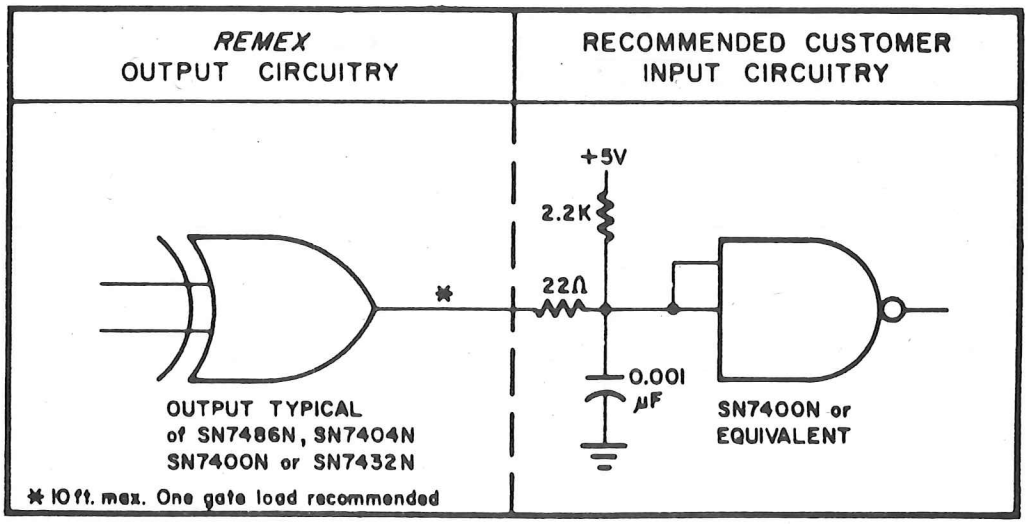
Figure 2-2 illustrates suggested drive and output circuitry with which to interface with the REMEX circuitry. Note the termination network for the output signals. This should be incorporated into the user's equipment for maximum noise elimination. Table 3-1 lists which circuit is used with each input or output.

NOTE: All input and output logic signals are defined for positive logic (mode 5), i.e., logic 0 = 0V and logic 1 = 5V. Therefore, signals that are 0V true (mode 6) for logic 1 (action condition) are written with a bar over the designation, e.g., $\overline{\text{Drive Right}}$ Input.



MMC 304A

Circuit A



MMC 305A

Circuit B

Figure 2-2. Recommended Interface Circuitry.

SECTION III

OPERATION

3.1 INPUT-OUTPUT SIGNALS

Table 3-1 lists those input and output signals which are routed through connector J1. The definition and/or usage of these signals are also included in the table. Figure 3-1 shows the timing diagram for these signals.

3.2 CONTROL FUNCTIONS

Table 3-2 lists the operating controls located on the front panel. A description of the controls and their functions is also included. It is recommended that the reader review the functions of these controls before operating the unit.

3.3 OPERATING INSTRUCTIONS

The following procedure should be used when loading and reading a tape.

3.3.1 LOADING INSTRUCTIONS

CAUTION

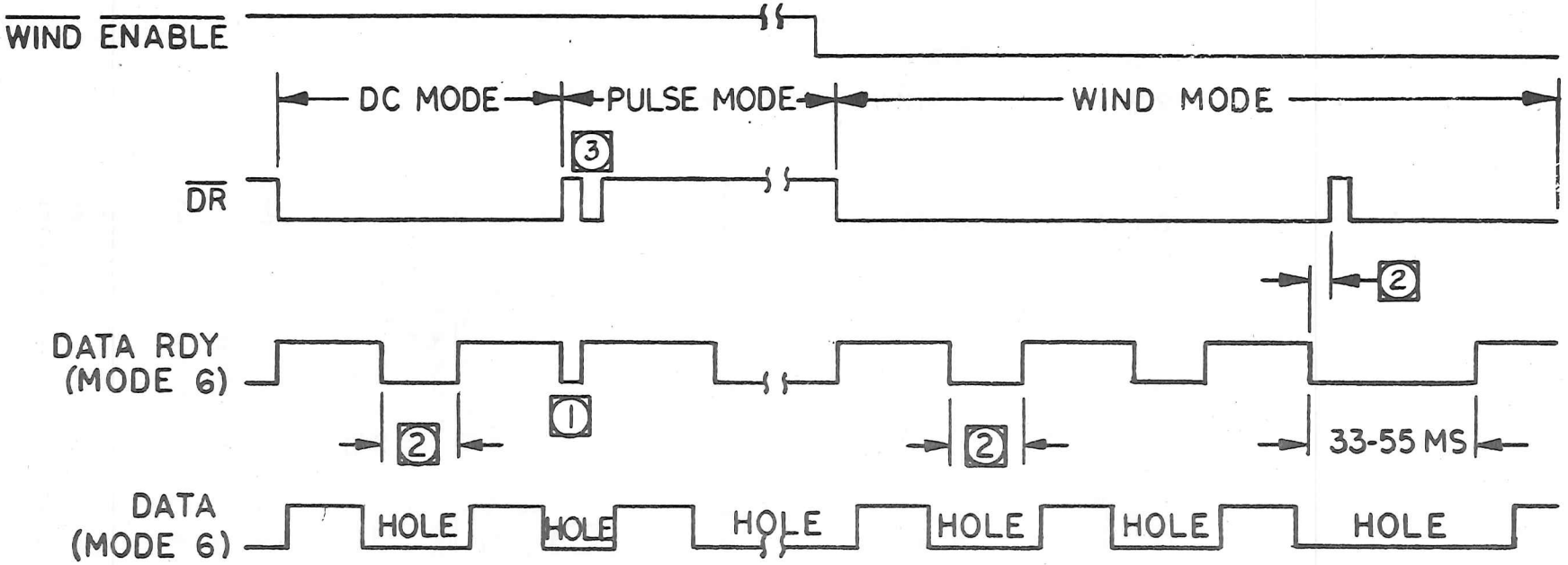
All units come wired for 115 or 230 VAC, 47-63 Hz operation. The proper input voltage must be selected as described in Section 2.4.1. In addition, before operating the system, the proper fuse value and carrier (as indicated in Table 1-1) must be inserted from the kit of parts. Discard the other fuse and carrier (unless, of course, a different voltage operation is anticipated).

a. Connect J1/P1 and plug the line cord into the AC connector.

b. Place the RUN/LOAD switch in the LOAD position.

c. Place the ON-OFF switch into the ON position. This will apply power to the unit.

d. Raise the Upper Tape Guide allowing tape to be loaded. Insert the tape to be read. See Figure 3-2. The edge of the tape nearest the sprocket holes goes next to the panel.



NOTES:

1. IN BOTH DC MODE AND PULSE MODE, THE DATA RDY SIGNAL GOES FALSE WHEN A NEW $\overline{DR}$ IS COMMANDED.
2. IN BOTH MODES, THE MAX DELAY AFTER DATA RDY TO STOP ON CHARACTER IS 500 μSEC.
3. DRIVE SIGNAL MUST REMAIN TRUE UNTIL DATA RDY GOES FALSE.

MMC 717

Figure 3-1. Timing Diagram for RR-7155.

e. Lower the Upper Tape Guide to its closed position and place the RUN/LOAD switch in RUN.

f. Make sure the System Ready output signal at J1-14 is in the true condition, i.e., $0 < V < +0.4$.

g. Apply $0 < V < +0.4$ to J1-10 to select mode 5 data output and data ready signals or $+2.4 < V < +5.0$ (or open circuited) to select mode 6. See Section 3.3.6.

h. The reader may now be operated in either of the modes listed in Section 3.3.2 or 3.3.3. See Section 3.3.4 for external inhibit operation.

i. To unload tape, stop tape movement, place the RUN/LOAD switch in LOAD, raise the Upper Tape Guide and remove the tape.

j. To remove power, place the ON-OFF switch in the OFF position.

3.3.2 TAPE DRIVE, READ MODE

In this mode of operation, the reader is controlled in either a continuous or a line-at-a-time step operation but is not completely synchronized with the reader outputs.

a. Perform Section 3.3.1, steps a through g.

b. Make sure the Data Ready signal at J1-9 is in the true condition depending upon the mode. See Table 3-1.

c. Place the $\overline{\text{Wind Enable}}$ input at J1-18 in its false condition ($+2.4 < V < +5.0$ or open circuited).

d. Apply the following signal to the $\overline{\text{drive left}}$ ($\overline{\text{DL}}$) line, J1-17 or the $\overline{\text{drive right}}$ ($\overline{\text{DR}}$) line, J1-16:

Stop: $+2.4 < V < +5.0$ (2.2K to +5V) or an open circuit
Run : $0 < V < +0.4$ @ 5 mA.

The drive signal can be either in the form of a pulse (asynchronous) or a continuous DC level (synchronous) which must be removed within 500 μsec after the leading edge of the true Data Ready signal to stop on character. A pulse must be maintained true until the Data Ready signal goes false (typically less than 0.5 μsec) and changed back to the false state in no more than 5 ms. The next pulse or D.C. level may be applied any time

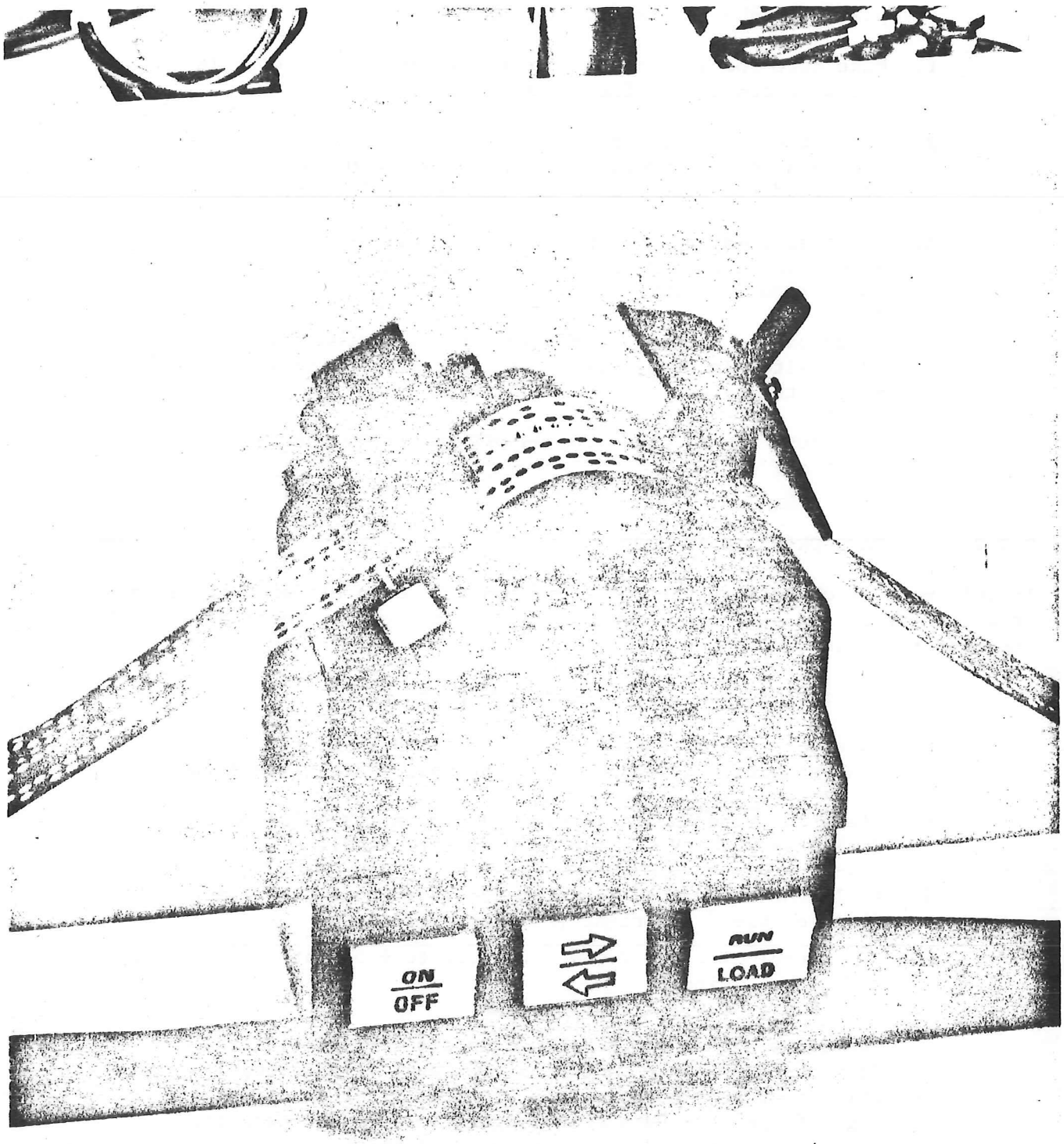


Figure 3-2. Tape Loading, RR-7155BA1/660.

after the Data Ready signal comes true. See Figure 3-1. In this mode of operation tape is driven at approximately 200 characters/sec.

e. Only one run signal must be present at one time. If both run signals are applied simultaneously, the reader will drive in the last previously commanded direction.

3.3.3 TAPE DRIVE, WIND MODE

In this mode of operation the reader is controlled in either a continuous or a line-at-a-time step operation, but must be completely synchronized with the Data Ready signal or else the drive signal can be locked out. This mode parallels the use of the direction switch and can be useful when rewinding fanfolded tape.

a. Perform Section 3.3.1, steps a through g.

b. Make sure the Data Ready signal at J1-9 is in the true condition depending upon the mode. See Table 3-1.

c. Place the $\overline{\text{Wind Enable}}$ input at J1-18 in its true condition ($0 < V < +0.4$).

d. Apply the following drive signal to the $\overline{\text{Drive Left}}$ ($\overline{\text{DL}}$) line, J1-17 or the $\overline{\text{Drive Right}}$ ($\overline{\text{DR}}$) line, J1-16:

Stop: $+2.4 < V < +5.0$ (2.2K to + 5V) or an open circuit
Run : $0 < V < +.04$ @ mA.

DC level input signal drives tape at approximately 400 characters/sec. Signal must be maintained until at least the next Data Ready signal goes true, but must be removed within 500 μsec after the leading edge of the true Data Ready signal to stop on that character. After the stop signal is applied, subsequent drive signals will be locked out for 20 to 25 msec before the reader can be driven again.

e. Only one run signal must be present at one time. If both run signals are applied simultaneously, the reader will drive in the last previously commanded direction.

3.3.4 EXTERNAL INHIBIT

In this mode of operation, the reader is inhibited and the $\overline{\text{System Ready}}$ output (J1-14) and the Data Ready output (J1-9) are set to the false

state. To place the reader in the inhibit mode apply the following signal to pin 15 of J1:

Reader Not Inhibited:	+ 2.4 < V < + 5 0 (2.2K to + 5V) or an open circuit.
Reader Inhibited:	0 < V < + 0.4 @ 5 mA.

3.3.5 MANUAL DRIVE MODE OPERATION

Tape can be driven manually at approximately 400 characters/sec either to the left or right as follows:

a. Perform Section 3.3.1, steps a through g.

b. Depress ← switch for drive left or the → switch for drive right as required. This mode can be useful when rewinding fanfold tape.

3.3.6 DATA OUTPUT MODE SELECTION

The output mode of both the data tracks and the Data Ready output is selectable for either Mode 5 (+ 5V true) or Mode 6 (OV true) by applying one of the following signals to J1-10:

Mode 5: 0 < V < + 0.4 @ 17 mA max.
Mode 6: + 2.4 < V < + 5.0 (or open circuit).

3.4 OPERATIONAL MAINTENANCE

After every 6 to 8 hours of use, the operator should check the tape transport area for cleanliness. This is extremely important since any dirt or foreign material covering the readhead can cause readout errors. For general cleaning, use the brush supplied. Cleaning of the readhead assembly area is described in Section 5.2.1.1. Make sure the tape remains clean at all times since any residue picked up by the tape can be deposited on the readhead. It has been found in certain cases that residue picked up by the tape comes from soiled hands. It is important that care be exercised when handling tape, especially in machining areas or other areas where grease, oil and sprays are present.

Table 3-1. Interface Signal Descriptions

Connector/ Pin	Description	Interface Circuit (see Figure 2-2)& I.C. Type	Signal Levels	
			True Condition	False Condition
J1-1 thru J1-8	Data Track Outputs. True signal indicates data track hole and false condition indicates no hole condition. Output mode 5 or 6, selectable (see J1-10).	B SN7486N	Mode 5:+2.4<V<+5 @0.2 ma (source) Hole (or Data Ready)	Mode 5:0<V<+0.4@16 ma (sink) No Hole (or Data Not Ready)
J1-9	Data Ready Output. True signal indicates data track outputs are in "on character" condition. Signal true with leading edge of feed hole and remains true until next drive signal is accepted. Data Ready signal is forced false by a load condition, external inhibit signal or out-of-tape signal. Output mode 5 or 6, selectable (see J1-10).	B SN7486N	Mode 6:0<V<+0.4 @16 ma (sink) Hole (or Data Ready)	Mode 6: +2.4<V<+5 @0.2 ma (source) No Hole (or Data Not Ready)
J1-10	Data Mode Select Input. True signal places data outputs and data ready output in mode 6. False signal places data outputs and data ready output in mode 5.	A SN7486N	+2.4<V<+5.0 (or open circuit) Data Track & Data Ready signals in mode 6.	0<V<+0.4 @ 17 ma max. Data Track & Data Ready signals in mode 5.
J1-11 thru J1-13,J1-24	Signal Ground (OV) to External Equipment. OV ground reference for all inputs and outputs (isolated from chassis ground).			
J1-14	System Ready (SYSRDY) Output. True signal indicates the RUN/LOAD switch is in its RUN position and none of the false condition signals are present (system ready). False signal indicates at least one of the following conditions is present: (1) RUN/ LOAD switch in LOAD, (2) the External inhibit signal present, or (3) if a drive signal is accepted and a new feed hole is not sensed within 25 ms., this output indicates either no tape or torn tape and serves as the out-of-tape signal.	B SN7400N	0<V<+0.4 @ 16 ma (sink) System Ready	+2.4<V<+5.0 @ 0.2 ma (source) System Not Ready

Table 3-1. Interface Signal Description, Cont'd

Connector/ Pin	Description	Interface Circuit (See Figure 2-2)& I.C. Type	Signal Levels	
			True Condition	False Condition
J1-15	External Inhibit (EXT INH) Input. True signal inhibits reader operation and causes System Ready and Data Ready signals to go false. False signal allows reader to operate in normal manner.	A SN7408N	0<V<+0.4 @ 5 ma. Reader Inhibited. Data Ready and System Ready signals False.	+2.4<V<+5.0(or open circuit) Reader not externally inhibited.
J1-16	Drive Right Input. True signal drives tape to right. See sections 3.3.2 thru 3.3.3.	A SN7400N	0<V<+0.4 @ 5.0 ma max. Reader drives tape.	+2.4<V<+5.0(or open circuit) Reader does not drive tape.
J1-17	Drive Left Input. Same as drive right except drives to the left.			
J1-18	Wind Enable Input. False condition and true drive signal drives tape continuously at 200 characters/sec. True condition and a true drive signal drives tape at 400 characters/sec.	A SN7400N	0<V<+0.4 @ 5 ma max. Tape drives at 400 characters/ sec.	+2.4<V<+5.0(or open circuit) Tape drives at 200 characters/ sec.
J1-19	+12Vdc @ 100 ma output available to external equipment.			
J1-20	① Wind Right External input. True signals winds tape to right.	A SN7400N	0<V<+0.4 @ 5.0 ma max. Wind active.	+2.4<V<+5.0 (or open circuit). Wind inactive.
J1-21	① Wind Left External input. True signal winds tape to left.			
J1-22	-12Vdc @ 100 ma output available to external equipment.			
J1-23	+5V @ 0.5 ma output available to external equipment.			
J1-25	Chassis ground; isolated from signal ground.			

① These inputs may not be present on earlier units.

Table 3-2. Front Panel Controls.

SWITCH	POSITION	FUNCTION
ON-OFF	OFF	Removes AC Power from reader.
	ON	Applies AC Power to reader.
RUN/LOAD	RUN	Enables tape reader.
	LOAD	Inhibits reader and places $\overline{\text{System Ready}}$ output in false state.
DRIVE CONTROL	←	Drives the tape to the left at approximately 400 characters/sec.
	→	Drives tape loop to right at approximately 400 characters/sec.

Table 3-3. Modes of Operation.

MODES OF OPERATION	DESCRIPTION
INHIBIT	System is in Inhibit mode (drive circuits inhibited) when (1) RUN/LOAD switch is in LOAD, (2) $\overline{\text{External inhibit}}$ input is true, or (3) End of Tape Sensor is true.
DRIVE	D.C. level or pulse input drives tape at 200 characters/sec., under the conditions described in Section 3.3.2 and Figure 3-1.
WIND	When $\overline{\text{Wind Enable}}$ input signal is true and D.C. input level is applied to $\overline{\text{DR}}$ or $\overline{\text{DL}}$, tape is driven at approximately 400 characters/sec.

3.5 TAPE RECOMMENDATIONS AND AVAILABILITY

The tapes listed in Table 3-4 are among those recommended for use. Mylar tapes should be used in applications requiring continuous use.

Table 3-4. Recommended Tapes.

Type	Manufacturer	Part Number
Paper, Unoiled or Oiled (except black carbon filled)	REMEX	715200-002 1000 foot roll 715200-001 Fanfold Tape
	Paper Manufacturers, Inc.	Perfection Series
	Bemis	Paper Tape Series
Special Paper	Numeridex	0500
	Nova Tech	Syntosil Machine Tool Tape
Special Mylar	Arvey	RVCX 60
	Chase Foster	PMP01151
	Numeridex	2000

NOTE: Black carbon tapes may be used but with reduced tape life.

3.6 TAPE PREPARATION REQUIREMENTS

Proper tape reader operation requires that the maximum accumulated longitudinal error between feed hole centers in the punched tape be ±0.025 inch within any span of 5 inches, as specified in the American National Standards Institute Standard X3.18-1974 (ANSI; formerly United States of America Standards Institute). In the event a user has, because of punching problems, a number of tapes which do not conform to this specification by an amount consistently out of tolerance, the reader may be set up as in Section 5.4 using one of these tapes rather than the type specified. However, unless absolutely necessary, the user should be encouraged not to do this since the reader performance may be compromised, especially in restricting the tape tolerances capable of being read.

A tape gauge is available from REMEX (part number 110597) so that the ±0.025 tolerance specification can be checked. To use the gauge, place the feed hole of one end of a 5-inch span (50 characters) at the single cross hair and swing the other end of the 5-inch span in the arc until one of the cross hairs is centered in the feed hole. Read the measurement adjacent to that cross hair (plus tolerances to the right and minus tolerances to the left). A second 5-inch gauge is printed at the bottom to check both longitudinal and perpendicular transverse center line spacing.

SECTION IV

THEORY OF OPERATION

4.1 BLOCK DIAGRAM DESCRIPTION

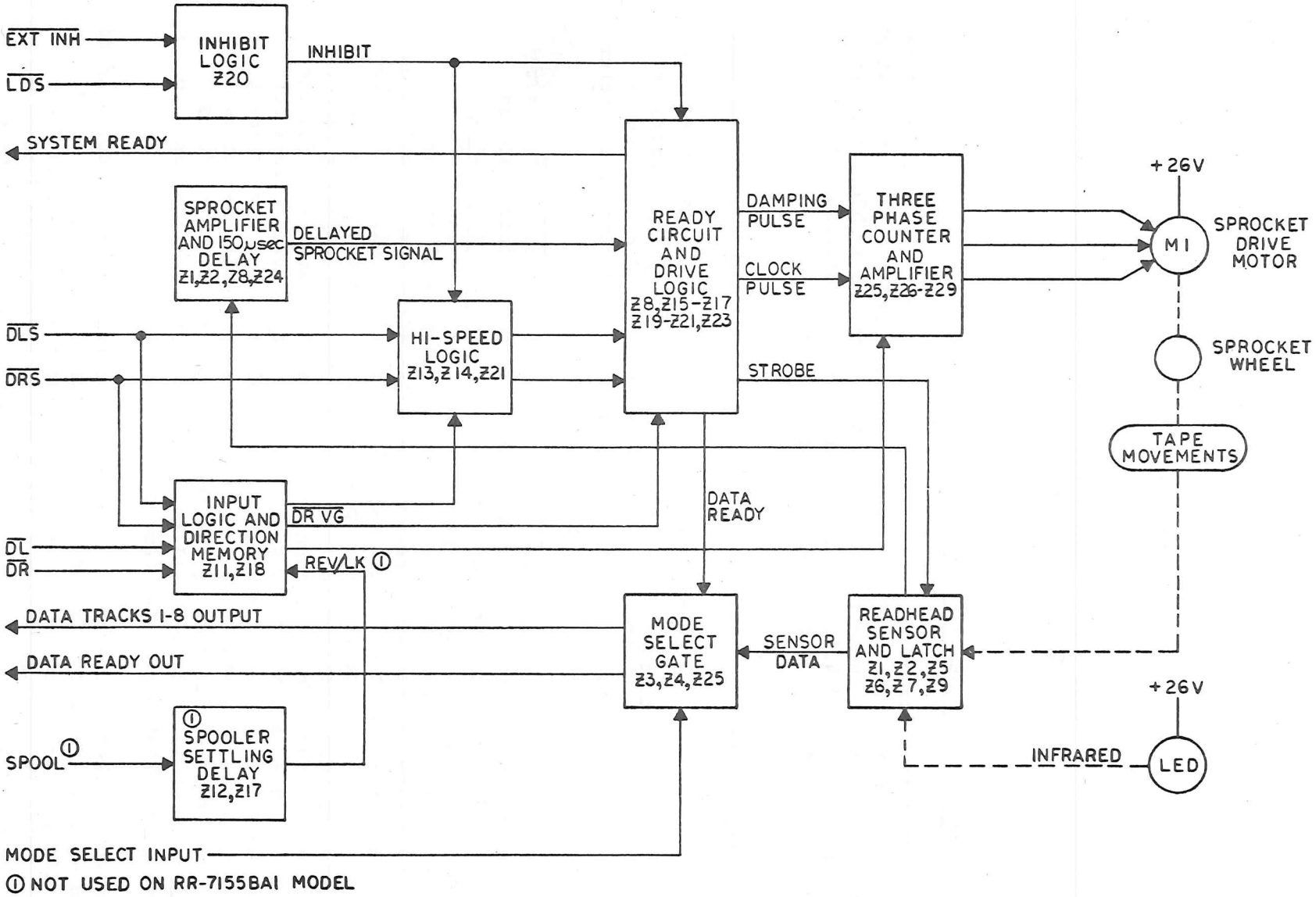
The REMEX Punched Tape Reader performs two basic functions: (1) it drives tape in either direction over the read station and (2) converts the tape information into electrical signals. These two functions are described in block diagram form in Sections 4.1.1 and 4.1.2 and illustrated in block diagram form in Figure 4-1. Figure 8-1 gives the overall system schematic.

4.1.1 TAPE DRIVE

Reader card 114321-003 contains the circuit logic for the RR-7155. This unit can be operated either at 200 characters/sec with the ($\overline{WIND}$) input false or at 400 characters/sec with $\overline{WIND}$ true (at OV). Operation at 200 characters/sec will be described first followed by the 400 character/sec description. Refer to Figure 4-1 for the Reader Block Diagram.

Applying a OV, true signal to the drive left ($\overline{DL}$) or drive right ($\overline{DR}$) input line sets the direction memory in the input logic to the desired state and establishes the direction of rotation for the motor by setting the three phase counter. The input logic also produces the true Drive Gate ($\overline{DRVG}$) signal which triggers the Ready Circuit. It is the function of the Ready Circuit to make sure the reader is ready to accept a drive command and, when the drive command is accepted, to generate the motor clock pulse (MCP). The MCP pulse is used to advance the three phase counter one count which steps the motor and, in turn, the tape to left or right one line depending upon the direction selected. The tape then stops on character and waits for the next MCP pulse. The Ready Circuit also locks out the sprocket signal for 2 ms after the MCP is generated so that any initial jitter in the sprocket is locked out as the tape starts up and the sprocket goes off character. At the end of the 2 ms time period, the Ready Circuit generates a 770 µs damping pulse which is applied to all three phases of the motor at once to minimize motor oscillations as the tape comes on character.

When the next sprocket hole is read, the sprocket output is amplified, delayed 150 µs and sent to the Ready Circuit. Upon receipt of the sprocket signal, the Ready Circuit generates the following three signals: (1) a Data Ready signal for use in external equipment, (2) a strobe signal which latches up the data from the readhead and (3) a 550 µs delay to allow data to be examined and make the stop-go decision. At the end of the delay, if the drive signal has not been removed, the read-drive cycle will be repeated and the tape will advance another line.



MMC 715A

Figure 4-1. Block Diagram Reader Circuitry.

In WIND operation (400 characters/sec speed), the WIND ENABLE line is pulled down to OV which sets the high speed flip-flop FF1. The drive sequence is similar to that described for low speed operation with the following exceptions: (1) the damping pulse is inhibited and (2) after the initial MCP pulse starts the motor advancing, a second clock pulse is generated as soon as the tape goes off character. This sets the three phase counter one count ahead of the line to which the tape is advancing. When that line is reached, the motor will not stop, unless the drive signal is removed, but will continue rotating one line more. Again when the tape goes off character, the counter is again pulsed. In this manner the counter is always one count ahead of the line being read on the tape. If, during the 550 µs data sampling period, the reader drive signal is removed, the counter backs up one count and causes the motor to stop on character. Another single shot is also set which allows a setting time of 45 ms.

The reader can be inhibited by any one of several methods: (1) placing the RUN/LOAD switch into LOAD causes the true OV LDS signal to be generated, (2) a true, OV, External Inhibit signal applied to J1-15. Items 1 and 2 are gated to form the Inhibit (INH) signal which inhibits both the High Speed Logic and the Ready Circuit and places the System Ready (SYSRDY) in the false state. The System Ready also goes false if, after receipt of a drive signal, no new sprocket is sensed within 550 ms, max., indicating that the reader is out of tape.

4.1.2 TAPE READING

The readhead is located under the LED source and contains phototransistor cells which are used to sense the punched tape perforations. As tape is advanced over the readhead by the sprocket drive, the phototransistor cells are energized by the LED source when the corresponding holes are present in the tape. Outputs from the readhead are then applied to the data track amplifiers and latch circuits. A true +5V, strobe signal locks up the two latch circuits, Z6 and Z7, thereby storing that line of data. The latch circuit outputs are applied to the Mode Select gates which produces either mode 5 or 6 outputs depending upon the level applied to the Mode Select input. At the same time, the Data Ready output signal goes true and it too is gated with the Mode Select signal.

4.2 CIRCUIT CARD DESCRIPTIONS

The following paragraphs describe the operation of the circuits which comprise the Reader Card Assemblies 114321-003 and -004 (used with 002 option; See Table 1-3). Figure 8-2 gives the schematics (5 pages) for the card. Circuit areas described in the text are referenced to the schematic by sheet number and zone coordinates on that sheet. For example, the location of the stepper motor, M1, would be referenced as 3C1, i.e., zone C1 of sheet 3. Logic devices are designated by the use of a Z followed by a number. An additional number may be added

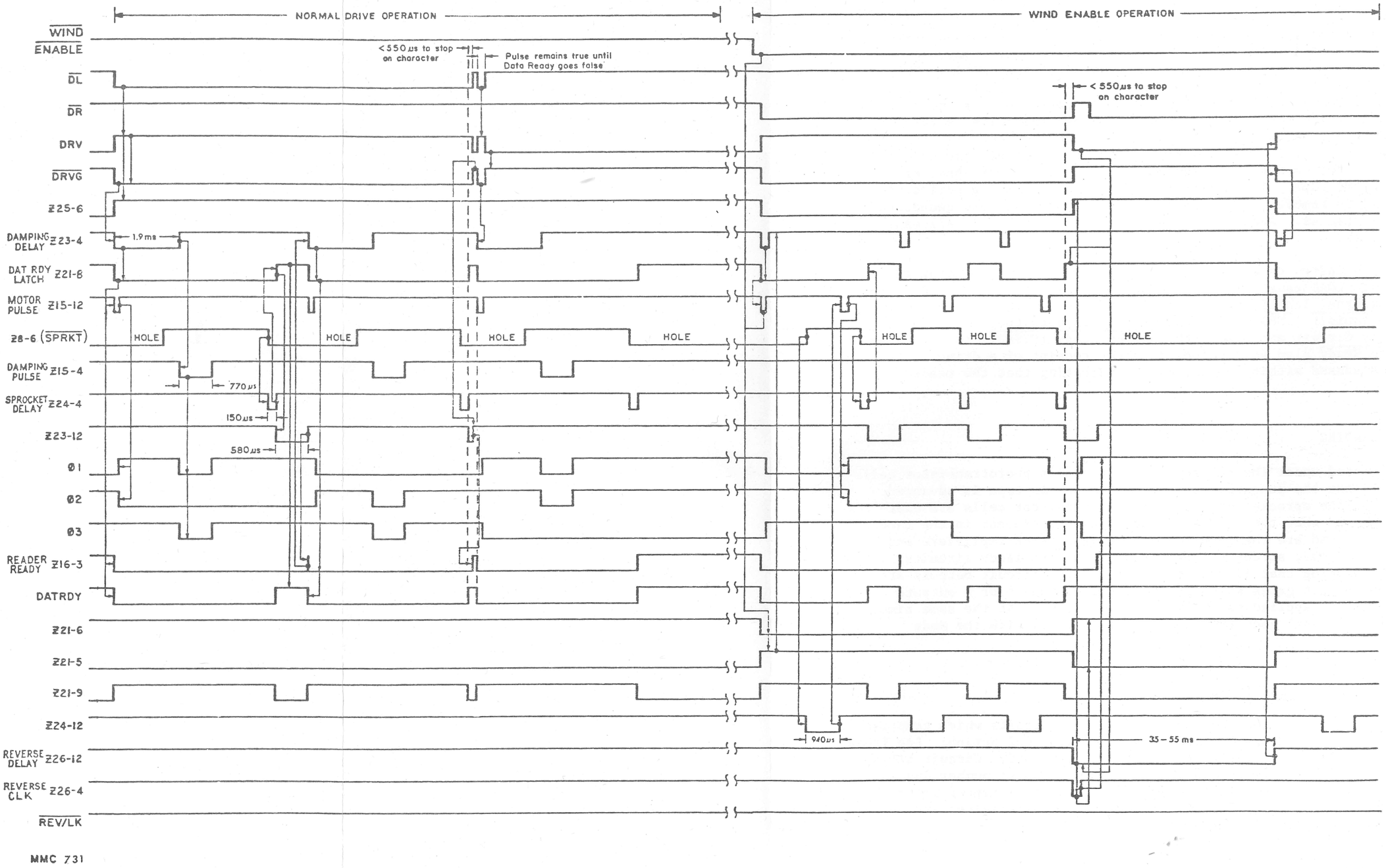


Figure 4-2. Timing Diagram, Reader Circuit Card.

when referring to a pin on a particular gate. For example, the External Inhibit input is applied directly to Z20-2 (4C7), i.e., pin 2 of Z20 shown on zone C7 of sheet 4. Since this schematic also covers the -001 and -002 cards, care should be used when applying this schematic to the -003 and -004 (used with 002 options) configurations.

4.2.1 READER CIRCUITRY

The reader circuitry on P.C. Card 114321 is used: (1) to generate output signals used to drive the stepping motor in response to the drive input signals and (2) to provide amplification and gating of the readhead data output signals.

4.2.1.1 Drive Circuits

During the following description, refer to Figure 4-2 which shows the waveforms and timing diagrams for the drive, step and wind enable operations. This figure is intended as a guide to show the sequence of events and which signals initiate other signals. It must be cautioned that due to the wide range of pulse widths, no attempt has been made to draw the time axis to exact scale. Refer also to the schematic, Figure 8-2, sheets 3 and 4, during this description.

Normal drive operation begins with the RUN/LOAD switch in the RUN position. In this position the inhibiting effects of the LOAD position are removed. See Section 4.2.1.3. Application of a true OV $\overline{DL}$ signal at J1-17 sets the direction flip-flop (F/F), composed of Z11 and Z18, to the drive left state. This places the CW RIGHT line at Z18-11 (3D6) at OV and causes Z25-6 to rise to + 5V (Z25-4 is at + 5V since the REVERSE DELAY circuitry is not enabled at this time). A + 5V signal at Z25-6 sets up a three phase counter (composed of Z25,Z28 and Z29) so as to energize the motor phases in the sequence which drives tape to the left, i.e., phase 3, phase 2 and then phase 1 (drive right is the reverse order). The counter is advanced one count with each motor clock pulse received as described in the next paragraph.

The OV, DL signal also generates the + 5V DRV signal which, in turn, generates the OV true Drive Gate ($\overline{DRVG}$) signal at Z22-3 (3D5). $\overline{DRVG}$ is used to set single-shot (S/S) Z23 at pin 1 (4B4) and remove the reset from Z23, pin 11. The output of Z23 at pin 4 then goes to OV which sets F/F Z21 at pin 10. Z21-8 subsequently goes low causing Z20-6 (4D3) to go low and trigger Z15 at pin 9. The output of Z15 at pin 12 is the Motor Clock Pulse signal which is used to set-up the three phase counter at Z29-1 (3B5). The counter is then advanced one count. The Motor Clock Pulse also triggers S/S Z17 at pin 1 (4D6). Since the REV/LK circuitry is not enabled at this time, REV/LK remains at + 5V DC.

A new motor phase is now energized which moves the tape one line to the left. Z21-8 also causes Data Ready (DAT RDY) to go false (OV) at Z20-11 (4B3).

Z21-9 stays set until Z23-4 times out (approximately 2 ms). As a result, any noise or start up jitter from the sprocket signal is prevented from generating a true DAT RDY signal.

At the end of the 2 ms period when Z23-4 goes high, Z21-10 is released and by this time, the tape is up to speed and the only signal available to reset Z21 is the positive going edge of the Delayed Sprocket Pulse from Z24-4.

The positive going edge of the signal at Z21-9 is also used to trigger S/S Z17 at pin 10 (4B2). This is a retriggerable S/S timed for approximately 550 ms and is used as an End of Tape Sensor. Its output at pin 12 is gated with the Z21-9 output at Z12, pins 4 and 5. If Z17 is not retriggered within the 550 ms and if no sprocket signal is sensed (Z21-9 remains high) then Z12-6 drops to OV. This places the SYS RDY signal at Z8-8 in the + 5V false state, indicating that the system is not ready. Readers which use the 002 option (See Table 1-3) use the 114321-004 assembly. This assembly is identical to -003 except it uses the End of Tape (E.O.T.) signal to power down the motor (3D3). When E.O.T. is high Q2 turns on which turns on Q3 and places + 26V across the Step Motor M1. If E.O.T. goes to OV, Q2 and Q3 turn off and R34 is switched in series with M1, thereby reducing the voltage on the stepper motor.

When Z23-4 times out, the positive going edge is used to trigger S/S Z15 at pin 2. The negative going output of Z15 at pin 4 is called the Damping Pulse and is applied to a negative OR combination at Z27, pins 5, 12 and 9 (3C3). The Damping Pulse causes the remaining two motor windings which are not energized during a given phase sequence to become energized by turning on the other two drive transistors of the following: Q4-Q6. This momentary energizing of all three motor phases dampens the inherent oscillations present in all stepping motors as the tape moves on character. The setting of R26 which controls the length of the Damping Pulse is described in Section 5.

When the next line of tape is read, the positive going sprocket signal is inverted at Z8-6 (4E4) and the resulting negative going edge triggers the 150 µs Sprocket Delay at Z24-1. This delay ensures that all data is available before the sprocket is recognized, and used to latch the data. At the end of the 150 µs delay, the positive going edge of Z24-4 resets Z21 at pin 11. The resulting positive going signal at Z21-8 is gated with the + 5V false Inhibit (INH) at Z20, pins 12 and 13 (4B3) to give the + 5V true DAT RDY signal. DAT RDY is used two places: (1) it is inverted at Z8, pins 10 and 12 to give the STROBE 1 and 2 signals which are used in the tape reading section (See Section 4.2.1.4) and (2) to trigger S/S Z23 at pin 10. Z23-12 provides a 580 µs delay by holding Z16-3 and, in turn, Z23-2 at OV and prevents another cycle. This allows the external equipment to examine the data and make the go/no-go decision. If the decision to stop is made, the DL input line must be taken high within 580 µs. Otherwise, when Z23-12 times out, Z23-2 will again be triggered and repeat the tape advance cycle. If the drive line is taken false and then returned to the true state during the 580 µs period, Z23 will be reset at pin 11 due to the DRVG signal at Z19-1 going high and the next drive sequence will begin immediately.

4.2.1.2 Wind Mode Operation

During normal tape reading operations, the WIND ENABLE input at J1-18 is taken high (or open circuited). A true OV signal applied to the WIND line at J1-18 and a true drive input will cause the reader to drive tape at approximately 400 characters/sec. Applying OV to Z13-4 (4E7) causes Z13-6 to go to + 5V and, in turn, Z14-8 goes to + 5V provided the drive signal is present (DRV is at + 5V at Z14-9). Note that Z14-8 will go to + 5V when OV from the direction switch (DLS or DRS) is applied to Z14, pin 4 or 5. With + 5V at Z14-8 (and Z13-9), Z13-8 is ready to go low when the first Motor Clock Pulse is generated and applied to Z13-13. When the drive signal is applied, the same sequence is generated as described in 4.2.1.1. When the first Motor Clock Pulse is generated in that sequence Z13-11 goes high causing Z13-8 to go low which sets F/F Z21 at pin 4.

The outputs of Z21 at pins 5 and 6 are used to modify the low speed drive sequence (see section 4.2.1.1) by performing the following functions: (1) Z21-5 inhibits the 770 μs. Damping pulse at Z15-1; (2) Z21-5 enables Z19-11 at pin 13 so that as soon as Z21-9 is set in the drive sequence, Z19-11 goes low and clears Z23 at pin 3 which removes the 2 ms damping delay; (3) Output Z21-5 along with the output at Z21-8 are combined at Z16, pins 12 and 13 (4D5) are used to enable Z26 at pin 10. The significance of Z26 will be described later; (4) Z21-6 holds Z20-5 low so that Z15-10 will be triggered by the output pulses from Z24-12 (discussed in the next paragraph); and (5) Z21-6 enables Z24 at pin 9 so that it is triggered by the positive going edge of the SPKT signal.

When the tape moves off character, the positive going SPKT is inverted at Z8-6 and triggers the 490 μs S/S Z24 at pin 10 (4D5). At the end of the 940 μs pulse, the positive going Z24-12 signal triggers Z15 at pin 10, causing a second Motor Clock Pulse to be generated. The Motor Clock Pulse is also applied to the counter and advances it one count ahead of the phase to which the motor is being advanced. Thus, when the next character is reached, if the reader has not been told to stop, the motor will continue advancing to the next character without stopping. Each time the tape goes off character, the counter will again be pulsed causing it to always be one count ahead. It should be noted that after the initial Motor Clock Pulse is generated by 21-8 going low, this signal does not generate any more Motor Clock Pulses since Z20-5 is held low. This coupled with the absence of the motor damping pulse SS3 allows the reader to drive tape at approximately 400 characters/sec.

If during the period that Z21-9 is reset and the drive signal is removed, (i.e., the drive signal is removed within the 580 μs decision time) the DRV signal will drop to OV and trigger S/S Z26 at pin 9. The resulting negative going output at Z26-12 performs the following functions: (1) provides a 45 ms REVERSE DELAY signal which is gated with the DRV signal at Z22, pins 1 and 2 (3D5) and inhibits the DRVG line and prevents another drive signal of the same direction to be applied within 45 ms (2) will reverse the direction of the motor counter at Z25-6 (3C6) by placing Z25-4 at OV; (3) triggers S/S Z26 at pin 1 (3B6). With motor counter direction line reversed, the negative going REVERSE CLOCK pulse from Z26-4

causes the three phase counter to back up one count which puts it in phase with the existing motor position, causing it to stop. The REVERSE CLOCK pulse is also applied to Z20-9 (4D6) and is used to reset F/F Z21 at pin 1 which takes it out of wind mode operation. When Z26-12 times out, the REV/DELAY line returns to + 5V. When Z17-4 times out, the REV/LK line returns to + 5V and the reader is ready to accept the next drive signal.

4.2.1.3 Inhibit Mode

Normal operation begins with the loading of the tape. Placing the RUN/LOAD switch into LOAD causes OV to be applied to Z20-1 (4C7) and in turn, places Z20-3 (the $\overline{INH}$ line) at OV. An $\overline{EXT\ INH}$ signal applied to Z20-2 produces the same results. The $\overline{INH}$ is used to perform the following functions: (1) it is applied to Z20-10 and the resulting pin 8 goes to OV which resets and inhibits Z21-1 at pin 1 if the reader was in wind mode operation; (2) it clears and inhibits Z21 at pin 13, thereby preventing recognition of any sprocket signal; (3) it is applied to Z20-12 which causes the DAT RDY line to be inhibited at OV. This will also place Z16-3 at OV and prevent the $\overline{DRVG}$ signal from triggering Z23 at pin 1; (4) with DAT RDY false, Strobe 1 and Strobe 2 are false which inhibits data from being latched; (5) it is applied to Z16-5 causing a false $\overline{SYSRDY}$ to be generated. After the tape has been loaded, placing the RUN/LOAD switch into RUN removes the above inhibiting effects and makes the reader operational.

4.2.1.4 Tape Reading Circuits

Hole recognition is by means of a phototransistor sensing array. Nine LED's housed above the tape path provide the illumination. The tape is driven over the top of the Photosensor Array Assembly housed in the Readhead Assembly and when a hole appears between the LED and phototransistor, the phototransistor becomes energized. See Figure 8-2, Sheet 2. Each output is applied to a Schmitt trigger circuit (Z1,Z5) and then thru a Level Converter circuit (Z2, Z9). Following the Level converter stage it is applied to a latch circuit, Z6 and Z7. Track 1 is used in the following discussion since it is typical of tracks 1-8 (the sprocket signal is developed differently as described in a subsequent paragraph). When track 1 is energized, Z1-3 drops to OV causing Z1-4, Z2-3 to be at + 12V level and Z2-2 to be at + 5V. Z2-2 is connected to the D_1 input of Z6. When the OV $\overline{Strobe\ 1}$ signal is generated, Z6 locks its output (Z6-16) corresponding to the input at Z6-2.

Track 1 output at Z6-16 is gated with the Mode Select signal at Z3, pins 1 and 2. A OV Mode Select input provides a Mode 5 output at J1-1 (i.e., OV for no hole and + 5 for the hole). Conversely, when the Mode Select signal is + 5V, J1-1 will produce a Mode 6 output (i.e., + 5V for no hole and OV for hole). The DATRDY output is gated in the same manner as the track output at Z25, pins 1 and 2.

The sprocket track is similiar but its level converted signal at Z2-4 is not latched as is the data tracks. It is inverted at Z8-6 (4E4) and used as an internal logic signal as described in Section 4.2.1.1. The SPKT is not gated with the Mode Select signal nor is it brought out as an external signal.

4.2.2 POWER SUPPLY

The power supply provides the regulated DC voltages required to operate the logic, LED's and spooler circuits. Figure 8-1 shows the front end of the supply. AC power is applied at J101 and switched through the POWER ON-OFF switch, S101. It is then passed through S104 which switches the power to the proper transformer windings, depending upon whether it is 115 VAC or 230 VAC. The transformer, T101 is a step-down transformer designed to convert the AC line voltage to approximately 40 VAC. The voltage from the transformer secondary is rectified by BR101 and filtered by C101 and C102. The resultant + 26 and - 28 Vdc voltages are applied to the reader card at J8, pins 3 and 2 (5B4). The + 26 and - 28 Vdc voltages are unregulated and used to provide power to the LED array assembly. The + 26 Vdc is also applied to the input of the 12V regulator Z33. The 5V regulator, Z34 is supplied from the 12V Regulator Z33. Regulator Z35 is used to convert the - 28V to - 12V. There are no adjustments in the power supply.

SECTION V

MAINTENANCE

5.1 GENERAL

The REMEX punched tape Reader has been designed to keep maintenance as simple as possible. Table 5-1 lists the maintenance equipment required for the various procedures. To prolong the life of the equipment and minimize down-time, certain checks and preventive procedures are set up in Section 5.2 and Table 5-2 with suggested schedules. Section 5.3 outlines possible malfunctions along with probable causes and remedies. The remaining sections describe the required adjustment procedures. Replacement procedures are given in Section 6.

Table 5-1. Maintenance Equipment Required.

	ITEM	QUANTITY
*	Frequency Counter, 10 Hz to 1 k Hz, 5V Input	1
	Miller-Stephenson MS-200 Magnetic Tape Head Cleaner (REMEX Part Number 716004-150)	1
*	Pulse Generator, 10 Hz to 1 k Hz, up to 5V amplitude, 1 μs to 100 ms width	1
*	Oscilloscope, dc to 10 M Hz, single sweep	1
	Tape Gauge, REMEX Part Number 110597	1
*	Voltmeter, Digital 0-0.1 mA, 0-100 m Vdc, 0-100 Vdc, 100K impedance or greater	1
*	Plastic Shim Stock, .010 Thick. Available from Artus Corp., 210 S. Dean St., Englewood, N.J. 07631.	
*	Neutral Density Filter, REMEX Part Number 716051-110	1

* Items not available from REMEX

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance, which includes cleaning and lubrication, should be performed periodically in order to maintain peak performance. In addition, in order that the warranty remain in effect, the unit must be maintained in accordance with the intructions outlined below (see Section 1.4 and page iii). A preventive maintenance schedule and log are presented in Table 5-2 which indicates the item, frequency of action and references the maintenance paragraph in this section. For customer convenience the table is arranged

so that a log can be kept of when each maintenance procedure was performed. Also refer to Section 3.4, Operational Maintenance.

NOTE

The frequency of cleaning as listed in Table 5-2 has been adopted for clean environmental conditions and usage. These items, however, may vary greatly from one installation to another. For example, a reader used in a machine shop to program numerical controls may require maintenance procedures considerably more frequently.

5.2.1 CLEANING

CAUTION

In all cleaning procedures, avoid using cleaning methods and materials other than those recommended in this manual. Do not use ethyl alcohol or denatured alcohol as the denaturing agents vary and may damage the reader. Certain cleaning compounds will damage parts of the reader, especially in the readout assembly area. REMEX primarily recommends the use of Miller-Stephenson MS-200 Magnetic Tape Head Cleaner (REMEX Part Number 716004-150) for most areas requiring cleaning. However, due to the degreasing nature of the cleaner, it should not be used in areas where the spray may come in contact with bearings or other oiled parts. This cleaner may be obtained from REMEX or directly from Miller-Stephenson Chemical Company at one of the following locations:

1001 East First Street
Los Angeles, California 90012

1350 W. Fullerton Avenue
Chicago, Illinois 60614

Route 7
Danbury, Connecticut 06810

To use the cleaner, hold the spray can 4 to 6 inches away from the area to be cleaned and allow spray to flush the dirt off. If a heavy build-up is present, loosen with the spray mist and scrub with a cotton swab. A 6-inch pin-point, spray nozzle extension is available for hard-to-reach areas or for delicate applications. Avoid spraying on lubricated surfaces or parts.

If the Miller-Stephenson cleaner is not available, a small amount of isophropyl alcohol applied to a clean, lint-free cloth or cotton swab may also be used. However, it should be used carefully and sparingly since damage to the photocell and the finish on the plastic cover may result. Use only clear, unadulterated isopropyl alcohol.

It is important that, whether the M-200 cleaner or the isopropyl alchol is used, only the amount required to clean the surfaces be applied. Never saturate or drench the areas to be cleaned. Never apply these materials to the LED assembly.

Table 5-2. Preventive Maintenance Schedule and Log.

Frequency* of Action Weeks	Date	Initial	Frequency* of Action Weeks	Date	Initial	5.2.1.1	5.2.1.2	5.2.1.3	5.2.1.4	5.2.3	5.4
						Cleaning				Check Adjust.	
2			28			X	X	X	X		
4			30			X	X	X	X		
6			32			X	X	X	X		
8			34			X	X	X	X		
10			36			X	X	X	X		
12			38			X	X	X	X		
14			40			X	X	X	X	X	X
16			42			X	X	X	X		
18			44			X	X	X	X		
20			46			X	X	X	X		
22			48			X	X	X	X		
24			50			X	X	X	X		
26						X	X	X	X	X	X
			52			X	X	X	X	X	X

* See Note on page 5-2.

5.2.1.1 Readhead Assembly Cleaning

The top surface of the readhead assembly should be cleaned every two weeks (for most installations having clean environments; dirtier environments which contain dust, oil and sprays, such as machining areas, may require cleaning as much as every eight hours). Cleaning is extremely important because any dirt or foreign material in this area can create errors in readout. Use the brush supplied or the cleaning material and methods described in Section 5.2.1 and clean the surfaces of the readhead assembly and the upper tape guide assembly. Care should be exercised so that no residue remains from the recommended cleaning materials when the cleaning operation is completed. Figure 5-1 shows the correct method of inserting the cleaning brush between the LED Array Housing Assembly and the Read Head Assembly.

5.2.1.2 Sprocket Cleaning

The sprocket wheel should be checked for cleanliness every two weeks. Depending upon tape conditions, accumulations may build up on the sprocket and be transferred to the sprocket holes in the tape which may cause readout errors. Use the recommended cleaning materials described in the caution in Section 5.2.1. Care should be taken so that the alignment of the sprocket wheel is not disturbed. If the sprocket wheel requires adjustment, refer to Section 5.4.

5.2.1.3 Tape Inspection

Repeated handling and usage of the tape leads to a build up of grease, oil and dirt on the tape. When the build up becomes excessive, this material will become lodged in the tape transport areas and could cause tape reading errors. To prevent this, the tape should be thoroughly inspected every two weeks and repunched as required.

5.2.1.4 General Cleaning

The entire reader should be cleaned every year. Use the following procedure:

> Using the brush supplied with the unit and/or compressed air, remove all dust and dirt, paying particular attention to all moving parts. Use the recommended materials described in the caution in Section 5.2 to remove any grease or other accumulations. When cleaning, use care not to damage components on the circuit board.

5.2.2 LUBRICATION

All points of rotation have permanently lubricated bearings and should not require lubrication for the life of the part.

5.2.3 POWER SUPPLY VOLTAGES

Check all volatages on the reader card listed in Table 5-3 with a voltmeter once every three months. A change in voltage may be indicative of a gradual component failure. Before taking any measurements, allow a short period of time for warm up after turning on power. See Figure 7-7 for location of test points.

Table 5-3 Power Supply Voltage Locations and Specifications.

Voltage and Tolerance	From	To
+ 5.0Vdc ± 0.2V	TP2	TP3
+12 Vdc ± 10%	TP17	TP3
-12 Vdc ± 10%	TP11	TP3
+26 Vdc ± 10%	TP16	TP3
-28 Vdc ± 10%	TP18	TP3

5.3 TROUBLE SHOOTING

Trouble shooting is presented in the form of a chart, Table 5-4, which should be consulted whenever tape reader performance is unsatisfactory. The chart is divided into three columns; Indication - the way in which the malfunctions becomes evident; Probable Cause - the possible reason or reasons for the malfunction; and Remedy - the manner in which the malfunction may be corrected.

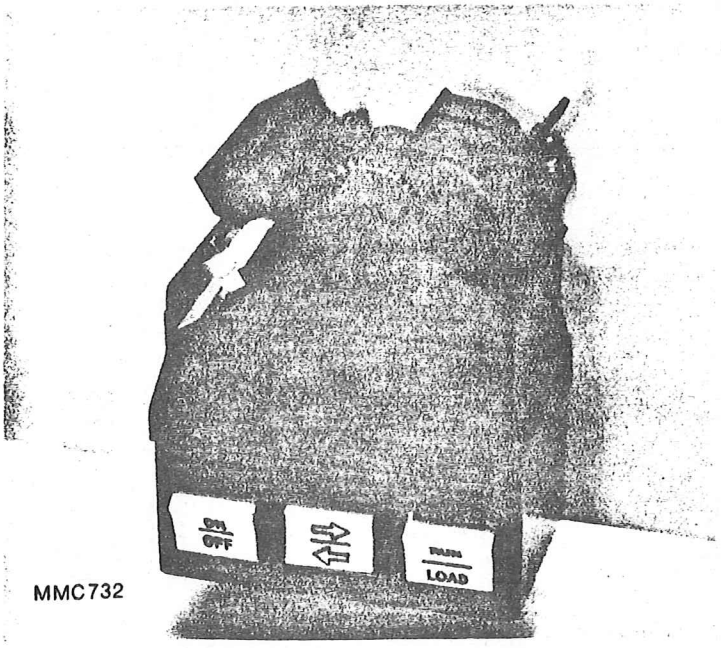


Figure 5-1. Proper Method of Inserting Cleaning Brush.

Table 5-4. Trouble Shooting.

Indication	Probable Cause	Remedy
1. No track outputs on any track.	1. Readhead dirty.	Clean Readjead Assembly as described in Section 5.2.1.1.
2. Outputs present on all but one track or one track intermittent.	1. Readhead dirty.	Clean Readhead Assembly as described in Section 5.2.1.1.
	2. Phototransistor defective.	Check the output of the Phototransistor assembly as described in Section 5.4 and replace if defective as described in Section 6.2.1.
	3. Defective component on Reader Card.	Check the components and I.C. modules associated with the particular track output.
3. Track output present with no hole punched in tape.	1. Tape transmissivity.	Tape must have a transmissivity of 57% or less as specified in Table 1-2.
	2. Defective phototransistor.	Check the output of the Phototransistor assembly as described in Section 5.4 and replace if defective as described in Section 6.2.1.
	3. Defective component on Reader Card.	Check the components and I.C. models associated with the particular track output.
4. RUN-LOAD switch in RUN, correct drive signals present; tape does not move.	1. RUN/LOAD switch defective.	Check switch S102 and replace if defective.
	2. Defective component on Reader Card.	Check operation of Reader Card.
	3. Step Motor Defective.	Check Ø1 thru Ø3 outputs from Reader Card to see if they are present. If so, replace stepper motor as described in Section 6.2.4.
5. Tape does not stop on	1. Improper Reader Alignment.	Perform Section 5.4.
	2. Defective component on Reader Card.	Check operation of Reader Card.

Table 5-4. Trouble Shooting (Continued).

Indication	Probable Cause	Remedy
6. Continuous tape speed less than 200 characters/second.	1. Tape out of registration.	Check tape registration to make sure tape conforms to specifications as described in Section 3.6.
	2. Sprocket out of rotational alignment.	Check alignment of reader as described in Section 5.4.
	3. Defective component on reader card.	Check reader for proper operation of drive circuits and single shot timings.
7. Irregular movement of tape.	1. Drive system improperly adjusted.	Perform Reader alignment as described in Section 5.4.
	2. Sprocket wheel bent or worn.	Replace sprocket wheel as described in Section 6.2.4.
	3. Tape guide assembly worn.	Replace tape guide assembly.
8. + 5V supply voltage too low or too high.	1. Defective regulator.	Check operation Z101 and replace if required.
	2. T101 malfunction.	Check for presence of 40 VRMS across the secondary terminals of T101. Replace T101 if not present.
	3. BR101 faulty.	Check operation of bridge rectifier BR101 and replace if faulty.

5.4 READER ALIGNMENT

Proper adjustment depends upon making and maintaining accurate adjustments. Although all adjustments are made at the factory, the following adjustments should be checked periodically (refer to Table 5-2) and should be performed only when the tape reader performance is unsatisfactory or when any of the following items is replaced: LED array, read head assembly, upper tape guide assembly, mechanism assembly, sprocket, step motor or circuit card. Letter designations in parenthesis refer to items called out in Figure 7-1.

Improper adjustment of this procedure will result in one or both of the following problems: (1) reading errors, especially in computer applications and (2) restriction of the tape tolerances capable of being read, i.e., either long or short tolerance tapes, not the ± 0.025 inch in either direction as specified in Section 3.6.

CAUTION

This is a factory set adjustment and should not require readjustment unless one of the aforementioned components has been replaced or the reader performance is unsatisfactory.

a. Remove all power and control signals by disconnecting P1 and the power cord plug.

CAUTION

The procedure outlined in steps b through i should not be performed unless the read head assembly, mechanism assembly, sprocket or step motor has been replaced or the reader performance is unsatisfactory. Prior to adjustment, steps b, d, e and f should be checked and corrective steps c and/or g, h, i and j performed only if necessary.

b. Remove the Upper Tape Guide. Check the clearance between the read head housing tape riding surface and the sprocket perimeter high point by placing the end of a small steel rule on the surface and rock the sprocket in both directions. See Figures 5-2 and 5-3. Observe that the perimeter high point clears the steel rule by a few thousandths of an inch. The sprocket teeth must have maximum tape penetration with no interference when driving tape. If the sprocket is not positioned as described, perform step c.

c. If the conditions of step b do not exist, loosen two screws (D) which hold the motor heat sink to the panel. Adjust the height of the motor so that the conditions in step b exist. Tighten screws (D). On some units it may also be necessary to loosen the two 8-32 socket head screws (B) at the rear of the panel

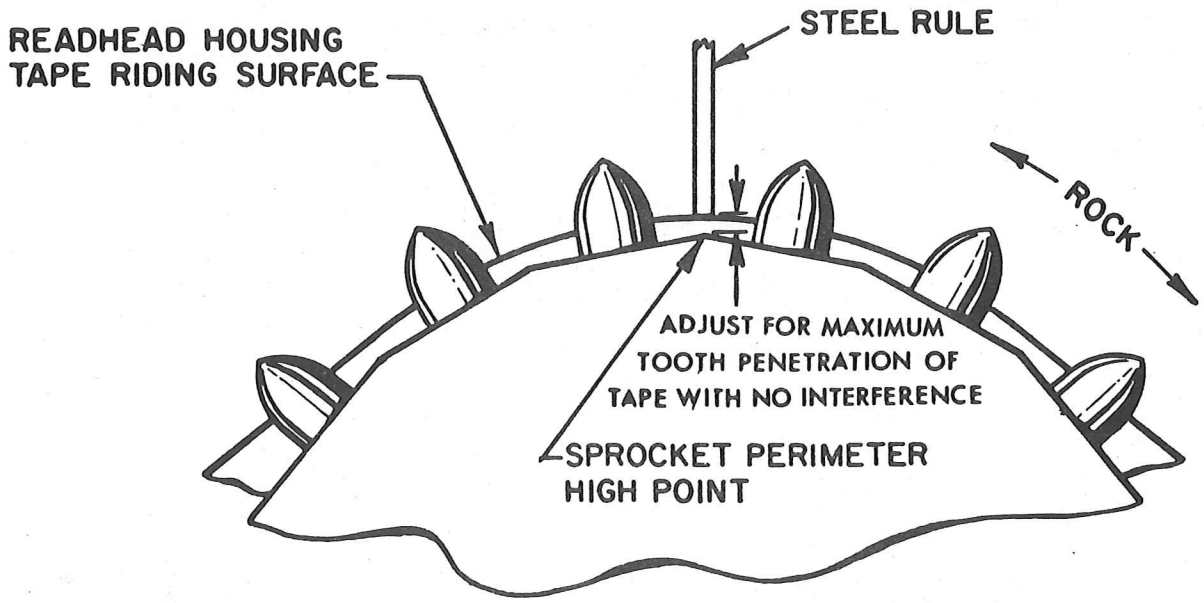


Figure 5-2. Sprocket Height Adjustment Technique.

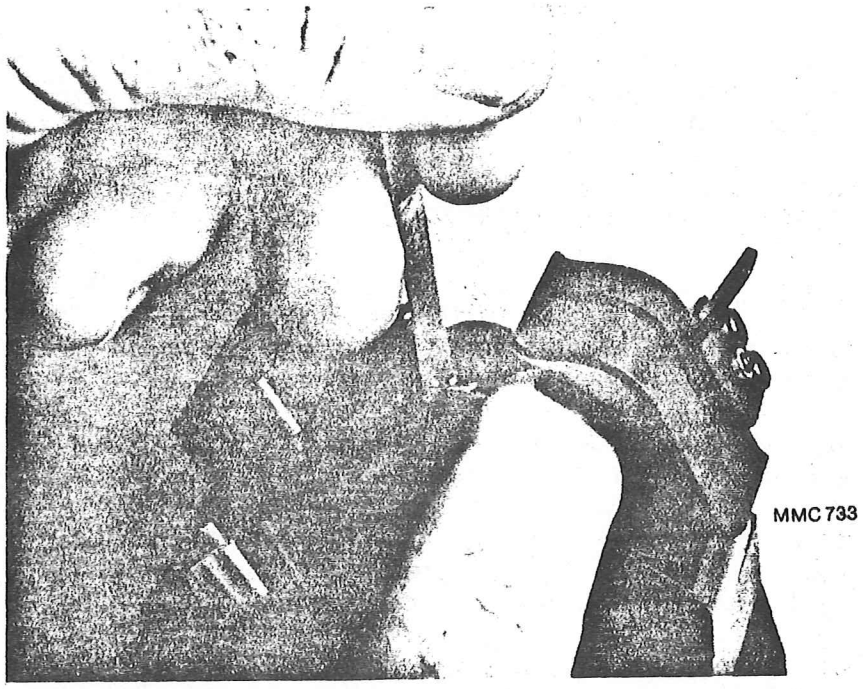


Figure 5-3. Sprocket to Readhead Clearance.

which hold the Mechanism Assembly to achieve the required setting. This should only be attempted if the adjustment cannot be made with the motor only. Tighten screws (B) if required. Check the conditions in step b again and perform step c as required.

WARNING

If the motor has been running for a period of time, it or the head sink may be too hot to touch comfortably. Allow sufficient time for the motor and heat sink to cool before any adjustment or use a cloth or pair of gloves.

d. Insert a loop of tape known to have been punched to within ± 0.0025 inch in a 5 - inch span (0.05% error).

NOTE

Since repeatablility of the feedhole placement in either direction is essential a tape whose accumulated error in a 5 - inch span is considerably better that 0.025 inches (as specified in Section 3.6) must be used in this procedure. REMEX specifies a tape known to be punched to within ± 0.0025 inch in a 5 - inch span (± 0.05% tolerance). Note that most REMEX punches are specified at ± 0.025 and therefore these tapes should not be used for this adjustment unless the tape has been checked on a registration gauge and found to be within ± 0.0025 inch.

e. Loosen the two 4-40 socket head screws which hold the LED Array Housing Assembly to the Mechanism Assembly and remove the LED Array Housing Assembly.

f. With the rear edge of the tape parallel to the front panel, align the holes over the light columns in the readout assembly so that they are concentric. See Figure 5-4. The tape must remain parallel to the front panel so that no skew is present. With the tape in this position, the sprocket teeth should be centered in the sprocket holes in the tape. Skewing is in-indicated by tracks 1 and 8 not being concentric.

g. If the conditions of step f do not exist, loosen the set screw (J) which holds the sprocket to the motor shaft and move the sprocket in or out on the shaft until the teeth are centered in the feed holes and the tape holes remain concentric with the light tunnels. Tighten screw (J). Recheck the adjustment and readjust as required.

h. Connect the power plug and place the POWER switch into the ON position. The motor should be energized.

i. Loosen the single screw which holds the motor to the heat sink.

j. Rotate the motor so that the holes in the tape are concentric with the light columns in the read head and the sprocket teeth are centered in the feed hole. Tighten the screw. Recheck the adjustment and readjust as required.

k. Remove the 0.05% tape.

1. Place the POWER switch in the OFF position.

m. Make sure jack screw (E) is not protruding below the surface of the Upper Tape Guide.

n. Insert three layers of 0.0037 mylar tape (approximately 0.011 inch) stapled together at one end or a piece of 0.010 plastic shim stock (see Table 5-1) between the Upper Tape Guide and the readhead assembly.

o. Referring to Figure 5-5 use screws (H) and (N) to adjust the Upper Tape Guide so that there is maximum contact, firm pressure on the tape, and parallelism from A to B. Use screw (H) for lateral movement and screw (N) for rotational movement. From points B to C, the Upper Tape Guide will not show this parallelism.

p. Remove the three layers of tape or the 0.010 plastic shim stock.

q. Insert two layers of tape between points A and B only or a strip of 0.0075 shim stock.

r. Screw down jack screw (E) which will raise the Upper Tape Guide slightly. Adjust screw (E) until there is free movement of two layers of tape or shim stock between points A and B. This whould provide a gap of between 0.009 and 0.011 inch.

s. Remove the two layers of tape or shim stock.

t. Replace the LED Array Housing Assembly and reconnect P1 and the Power Cord.

u. Install a 30% neutral density filter (REMEX P/N 716051-110) between the LED Array Housing Assembly and the Read head Assembly.

v. Using a digital voltmeter, measure the voltage of the pins listed below for P2. Adjust each corresponding potentiometer for 6 Vdc ± 0.1V.

Track	P2-Pin	Potentiometer
1	2	R1
2	3	R3
3	4	R5
FH	5	R7
4	6	R9
5	7	R11
6	8	R13
7	9	R15
8	10	R17

w. Remove the voltmeter and the neutral density filter.

x. Place the POWER switch in the ON position and insert the 0.05% tape described in step d.

y. Connect a pulse counter to TP6 (Data Ready) and TP3 (OV) on the Reader Card.

z. Measure the drive left speed using a $\overline{DL}$ signal tied to OV at J1-17. Repeat using a $\overline{DR}$ signal tied to OV at J1-16. If the lowest speed is more than 5% slower than the highest speed, loosen screw (S) which holds the motor to the heat sink. Rotate the motor slightly so that the difference in drive left and drive right speeds is less than 5%. Tighten screw (S). Repeat step z as required. When rotating the motor, make sure it is kept tight to the panel so that the adjustment in step g is not disturbed. If steps g and j have been performed correctly only a slight adjustment of the motor should be necessary to obtain the 5% difference in speeds.

NOTE

The importance of steps y and z is not a specific interest in matching speeds, but rather that balancing speeds insures proper placement of the feedhole (via the sprocket) in relation to its aperture in the readhead. The 0.05% tape used virtually assures that there are no feedhole placement errors which are attributable to tape registration errors, but only to the position of the sprocket in relation to the feedhole aperture in the readhead. Thus measuring and balancing the slew speed is only an accurate, electronic method of assuring that this relationship exists. When the speeds in the two

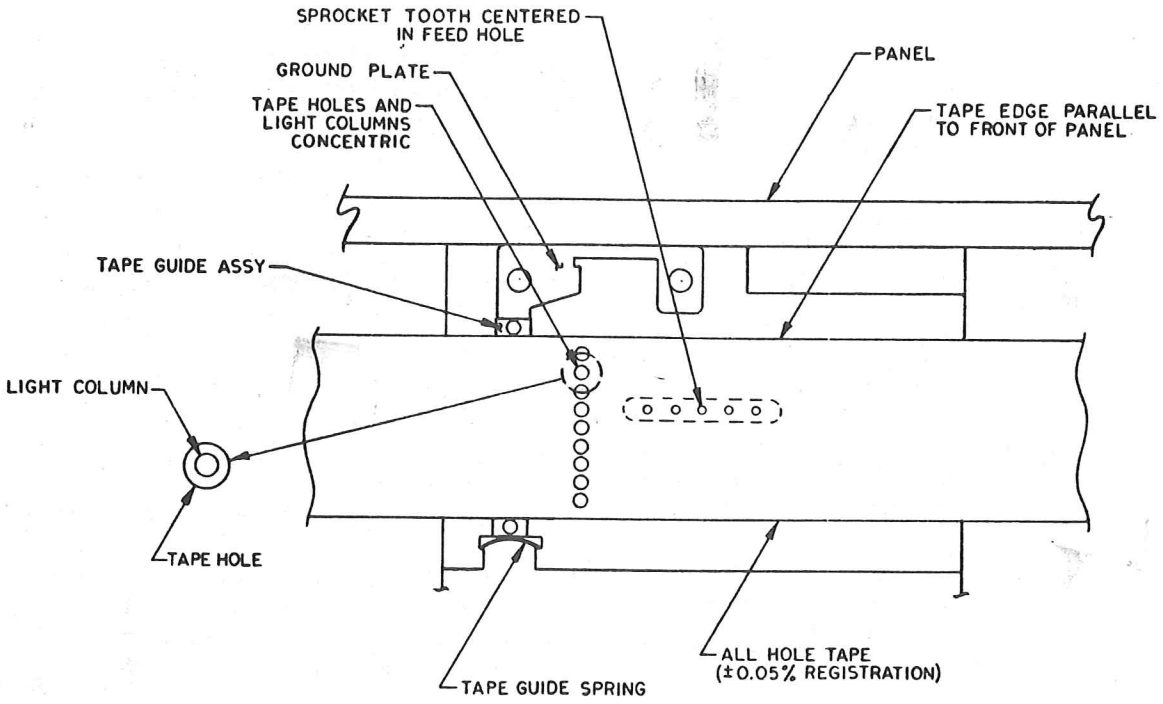


Figure 5-4. Alignment of the Sprocket with the Light Columns.

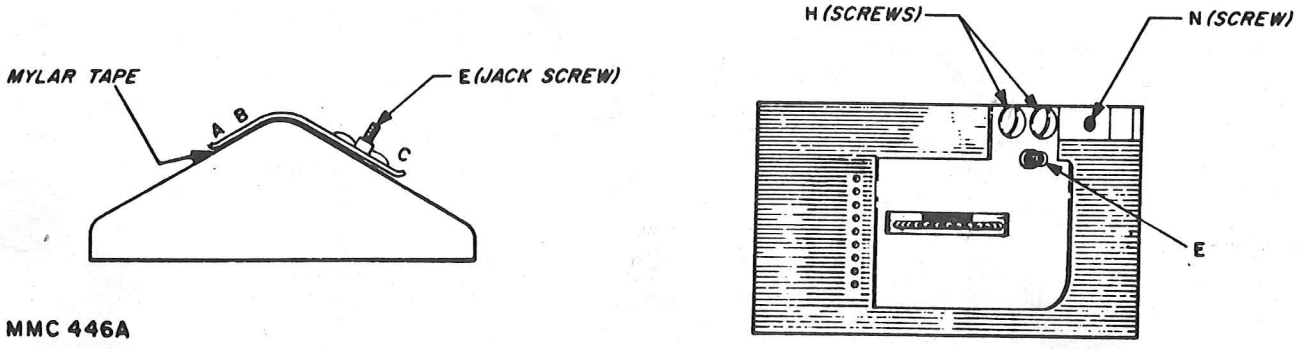


Figure 5-5. Adjustment of the Upper Tape Guide.

directions are properly balanced, feedhole placement error will be minimal and independent of the direction of the tape, thereby increasing tape readability to a maximum.

aa. Connect the oscilloscope probe to TP9 and the ground lead to TP3. Drive tape at low speed (See Section 3.3.2) and observe the damping pulse at TP9. This pulse should be 710 µs ± 150 µs. Adjust R24 to obtain the correct pulse width.

bb. Connect the oscilloscope probe to TP8 and the ground lead to TP3 and observe the pulse width which should be 2.9 ms ± .4 ms. Adjust R29 to obtain the correct pulse width.

cc. Connect the oscilloscope probe to TP1 and observe the jitter. The maximum height of the interpulse noise must be less than 25% of pulse height. If this is not the case readjust R24 and R29 to obtain the conditions. Repeat steps aa and bb as required. Do not exceed the tolerance limits placed on pulses observed at TP9 and TP8.

5.5 TAPE SPLICING

If tape breakage occurs, this break may result in damage to one, two or possibly three characters. When splicing tape for this reader, great care should be used to ensure that the proper sprocket hole spacing be preserved. A lap splice should not be used; use only a butt type splice. To repair the tape without loss of characters, the process shown in Figure 5-6 is recommended and is accomplished as follows:

a. Bring the tape ends together as shown in Figure 5-6A.

b. Make a sketch of character(s) at the break (A-B-C) and five additional characters to the left (5-4-3-2-1) and five to the right (1-2-3-4-5) of the broken character(s) (A-B-C).

c. Place the left end of the broken tape over a section of blank tape containing only feed holes so that at least eight or ten feed holes in each tape are aligned with one another as shown in Figure 5-6B. Cut the tapes at the third undamaged character (A-B-C). Use care to insure that feed holes are aligned and make cut through the center of the holes in the third undamaged character. Characters 5, 4 and half of 3 should remain on the broken tape.

d. Place the right end of the broken tape over the section of blank tape so that at least eight or ten feed holes are aligned with one another. Feed holes for one-half of 3, 2 and 1 on the blank tape cut in step c should be visible to the left of the broken tape end as shown in Figure 5-6C.

Cut the tapes at the third undamaged character to the right of the damaged character. Be sure that the feed holes are aligned and make the cut through the center of the holes in the third undamaged character.

NOTE

One-half of character 3 and characters 4 and 5 should remain in the broken tape.

e. Place tape ends and new section on a flat surface with feed holes forward as shown in Figure 5-6D (tape is bottom side up). Using silver Scotch tape, No. 852, splice the new section and the old tape ends as shown. That portion of tape that secures the old tape ends must cover the first two and a half characters (one-half of 3, 4 and 5) on the old tape ends. The edges of the tape should be between characters as shown. Use of 1/2-inch wide splicing tape is recommended as shown in Figure 5-6D.

f. Repunch the characters recorded in step d.

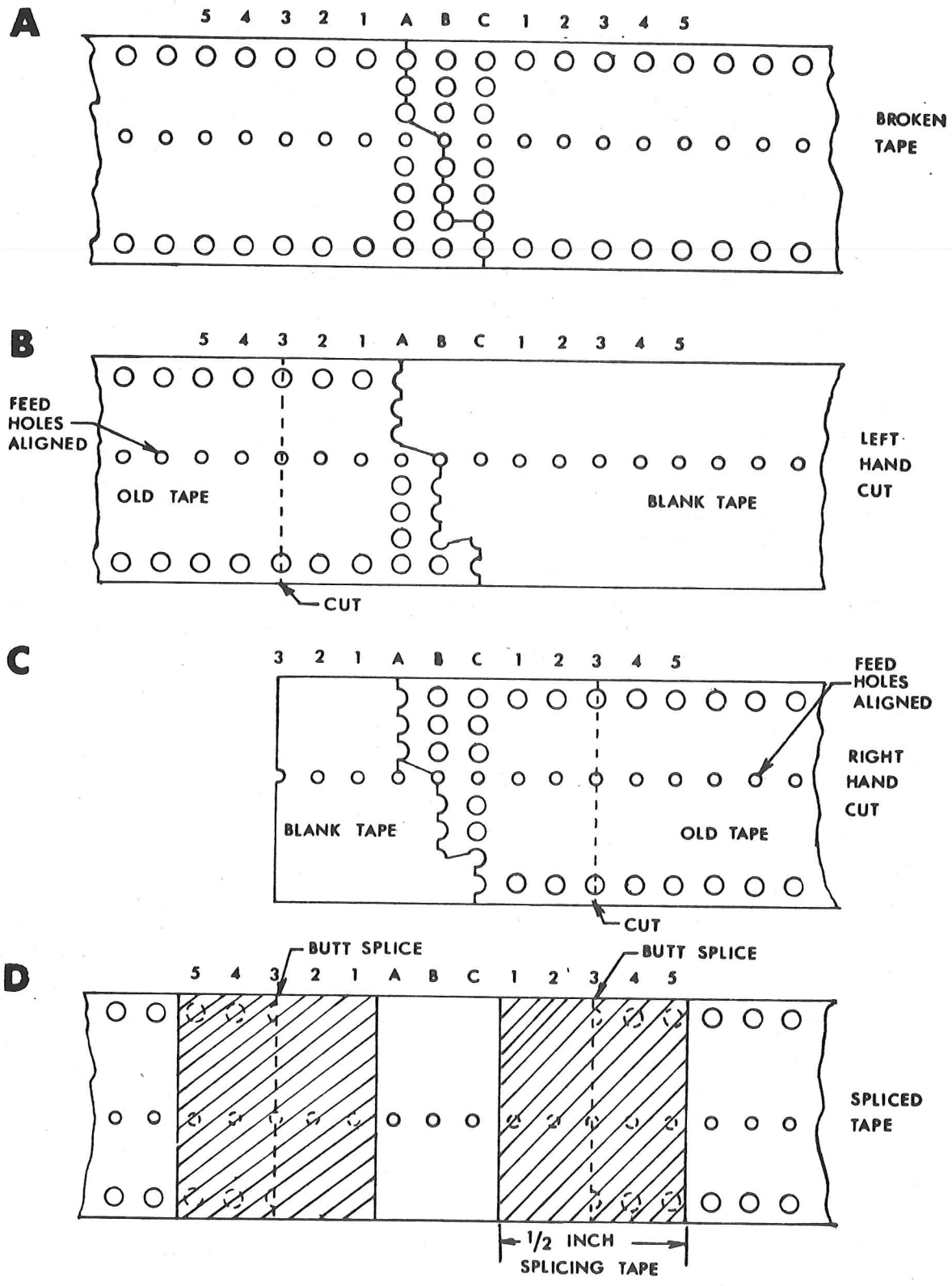


Figure 5-6. Tape Splicing Procedure.

SECTION VI

PARTS REPLACEMENT

6.1 GENERAL

REMEX maintains service facilities at its manufacturing location and at service centers in major population areas for repair or replacement of components for their products. It is recommended that one of these centers be contacted for assistance in case of equipment malfunction. For the location of service facilities in any area, contact REMEX at the address listed on the title page of the manual. Please direct inquiries to the attention of the Service Department.

When any parts of the reader require replacement or disassembly, the procedures below should be followed closely. The warnings and cautions are included to protect personnel and equipment. Notes are included to assist persons unfamiliar with the equipment. Before attempting any procedure, all instructions for that disassembly should be read and understood.

Quantities of replaceable items suggested as spares are listed in Table 7-1. All system components are identified in Section VII of this manual, along with illustrations showing part locations. This information may be used to locate parts below unit level if replacement is required.

Potentially dangerous line voltage is applied to components within this equipment. If adjustments must be performed with power applied, these points must be located and avoided. High voltage can be accidentally contacted at TB101, at the OFF-ON switch/wiring connections, and on the circuit card (rear of the unit).

6.2 READER PARTS REPLACEMENT

6.2.1 READHEAD MECHANISM DISASSEMBLY

This procedure is required when replacing the Upper Tape Guide Assembly, the Readhead Assembly (consisting of the Readhead Housing, Phototransistor Assembly

and Light Columns), or the Mechanism Assembly. For ease of assembly, it is recommended that the Readhead Assembly (part number 114352-001) and Mechanism Assembly (part number 112346-001) be replaced as a complete assembly. Figure 7-1 should be folded out from Section 7 to follow during this procedure. The following procedure is recommended when replacing any of the above mentioned items:

a. Remove all power and control signals by disconnecting P1 and the power cord.

b. Disconnect P2 from the circuit card.

c. Remove two 4-40 socket head screws (C and F, Figure 7-1) which hold the LED Array Assembly to the Readhead assembly.

d. Loosen the two 8-32 socket head screws (Item B, Figure 7-1) which hold the Mechanism Assembly to the Front Panel at the rear of the front panel. The entire Readhead Mechanism Assembly consisting of the Tape Guide Assembly, The Readhead Assembly, and the Mechanism Assembly is now free to be removed from the panel.

e. Remove the two 4-40 binder head screws (Item H, Figure 7-1) which hold the Tape Guide Assembly to the Mechanism Assembly. If no further disassembly is required, install the new Upper Tape Guide Assembly and perform the reverse of steps e through c. Perform Section 5.4.

f. From the underside of the Mechanism Assembly remove the two 4-40 round head screws (Item I, Figure 7-1) which hold the Readhead Assembly to the Mechanism Assembly. The Readhead Assembly and the Mechanism Assembly are now separated and can be replaced as individual assemblies. It is not recommended that Mechanism Assembly be disassembled beyond this level.

g. Reassembly is the reverse of steps f, e, d and c.

h. Perform Section 5.4.

6.2.2 READER CARD REPLACEMENT

The following procedure is recommended when removing the Reader Card:

a. Remove all power and control signals by disconnecting P1 and the power cord.

b. Disconnect P2/J2, P4/J4, P5/J5 and P8/J8.

c. Remove the nine 4-40 round head screws which hold the reader card to the chassis and P.C. Board spacers.

d. Reassembly is the reverse of steps c and b.

e. Perform Section 5.4.

6.2.3 MOTOR AND/OR SPROCKET REPLACEMENT

The following procedure is recommended when replacing the motor and/or sprocket:

a. Remove all power and control signals by disconnecting P1 and the power cord.

WARNING

If the motor has been running for a period of time, it or the heat sink may be too hot to touch comfortably. Allow sufficient time for the motor and heat sink to cool before adjusting or use a cloth or pair of gloves.

b. Loosen the screw (Item S, Figure 7-1) which holds the motor to the heat sink and back the motor out.

c. Loosen the set screw (Item J, Figure 7-1) which holds the sprocket to the motor shaft.

d. Install the new sprocket on the new motor and perform the reverse of steps c and b. The sprocket wheel is installed so that:

(1) the distance from the rear of the sprocket to the front panel is 0.862 inch (see Figure 7-1) and
(2) the 1/8 inch long set screw tightens on the flat of the motor shaft. This is a preliminary step. The final setting of the sprocket is performed in Section 5.4.

e. Perform Section 5.4.

6.2.4 TRANSFORMER REPLACEMENT

The following procedure is recommended when replacing the transformer:

a. Remove all power and control signals by disconnecting P1 and the power cord.

b. Remove the seven wires from T101 at the locations indicated in Table 6-1.

c. Loosen the two pop rivets which hold the transformer to the

chassis and remove the transformer.

d. Install the new transformer by performing the reverse of steps c, b and then a. Refer to Table 6-1 for transformer wire connections.

Table 6-1. Transformer Wire Connections

From	To	Wire Color
T101-1	S104-1	Black
T101-2	S104-5	Red
T101-4	S104-2	Yellow
T101-5	S104-4	Green
T101-6	BR101-1	White
T101-8	C101	Brown
T101-10	BR101-2	Violet

6.2.5 FRONT PANEL AND CHASSIS SEPARATION

The following procedure is recommended when separating the front panel from the chassis:

a. Remove all power and control signals by disconnecting P1 and the power cord.

b. Disconnect the following connectors on the Reader card: J2/P2, J4/P4 and J5/P5.

c. Disconnect P102/J102.

d. Remove the four 10-32 binder head screws which hold the front panel to the side brackets. The front panel and chassis can now be separated.

e. Reassembly is the reverse of steps d, c, b and then a.

SECTION VII

PARTS LIST

7.1 GENERAL

Listed in Table 7-2 are the electronic and mechanical parts used in the RR-7155BA1/660. Indented items are part of the assembly under which they are indented and the quantity of these items are per each assembly. Table 7-1 lists the recommended spare parts and the quantity column denotes the number recommended. Table 7-3 contains the components used on the printed circuit card. Figures 7-1 through 7-4 illustrate the parts listed in Table 7-2. Those items identified by a broken arrow indicate the approximate location of parts not visible in the photograph.

Reference designations refer to the parts illustrated in Figures 7-1 through 7-5. All electronic components are identified by letter-number combinations in the Reference Designation column and mechanical parts are identified by number. Reference designations contained in parenthesis are associated or function with the parenthetical item. These items are generally individual items and not part of an assembly but for reference are related back to the associated item. All items are available from Spares Order Desk, REMEX 1733 Alton St., P.O. Box C-19533, Irvine, California 92713.

7.2 KIT OF PARTS

The kit of parts contains items used for installation and maintenance and is shipped with the unit. Refer to Table 1-1.

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM (IF PRESENT) AT THE REAR OF THE MANUAL FOR POSSIBLE PART NUMBER CHANGES.

Table 7-1. Recommended Spare Parts, RR-7155BA1

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Bridge, Rectifier, Motorola MDA 2501	704005-143	1	BR101
Printed Circuit Card, Reader	114321-003 (1)	1	PC1
Readhead Assembly	114352-001	1	
LED Array Housing Assembly	114362-001	1	
Switch, ON-NONE-ON, C&K L21Z3X36	715036-111	1	S101,S102
Switch, (ON)-OFF-(ON), C&K 5205Z3BX36	715063-114	1	S103
Switch, AC Selector, DPDT, Switchcraft 46256LFR	715075-111	1	S104

(1) When the 002 option is used this card is 114321-004 (See Table 1-3).

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM (IF PRESENT) AT THE REAR OF THE MANUAL FOR POSSIBLE PART NUMBER CHANGES.

Table 7-2. Parts List, RR-7155BA1

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Top Assembly, RR-7155BA1/660/---/UXXX	814470-001	1	Ref.
. Chassis Assembly Power Supply	114469-001	1	Ref.
. . Bridge, Rectifier, Motorola MDA 2501	704005-143	1	7-2, BR101
. . Capacitor, 6.3 µf, 40V Cornell Dubilier FAH632-40-A3	702313-108	2	7-2,C101,C102
. . Capacitor, 0.01 µf, 1.4 kV Ceramic Disk, Erie 3848Z5U103M	702136-103	2	7-2,C103,C104
. . Chassis, Power Supply	114317-001	1	7-2,1
. . Clamp, Capacitor, Richo SCH-1	715045-153	2	(C101,C102)
. . Connector, AC, 3-pin, Switchcraft EAC-301	706500-296	1	7-3,J101
. . Connector, 4-pin, Molex 03-06-1042	706510-339	1	7-2;J102
. . Connector, 3-pin, White Molex 09-50-7031	706510-258	1	7-2,P8
. . Contact, Connector, Molex 02-06-1103	706530-156	4	(J102)
. . Contact, Connector, Molex 08-50-0106	706530-137	3	(P8)
. . Fuseholder, Schurter 031-1673	705750-120	1	7-3,F101
. . Lug, Capacitor, Amp 31887	715005-110	10	(C101,C102, E101)
. . Plate, Side	114314-001	2	7-2,3
. . Printed Circuit Card, Reader See Table 7-4 for Card Components	114321-003	1	7-3,PC1
. . Switch, AC Selector, DPDT Switchcraft 46256LFR	715057-111	1	7-3,S104
. . Terminal, Faston .188, Amp 2-350800-2	715005-143	11	(T101)
. . Terminal, Faston .250, Amp 2-350804-2	715005-145	4	(BR101)
. . Transformer, REMEX Specification	703010-173	1	7-2,T101
. Cover Rear	114374-001	1	
. Decal Caution	111933-001	1	
. Decal, Serial No.	716018-113	1	
. Front Panel Assembly	114468-001	1	Ref. 7-1
. . Heat Sink, Step Motor	110448-002	1	7-1,5
. . Motor Assembly, Stepper	110862-001	1	7-1 (M1)
. . . Connector, Housing, Yellow, 6-Pin Molex 09-50-7151	706510-266	1	7-1,P5
. . . Contact, Connector, Female, Burndy 4823	706530-138	6	(P5)
. . . Motor, REMEX Specification	715075-158	1	7-1,M1

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM (IF PRESENT) AT THE REAR OF THE MANUAL FOR POSSIBLE PART NUMBER CHANGES.

Table 7-2. Parts List, RR-7155BA1 (Continued)

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
. Front Panel Assembly (Continued)			
. . Panel Front	114467-001	1	7-4,2
. . Readhead Mechanism Assembly	114350-001	1	Ref. 7-1
. . . Clamp, Cable, Weckesser A-30	715040-139	1	
. . . Ground Plate Assembly	114367-001	1	7-1,13
. . . LED Array Housing Assembly	114362-001	1	7-1,14
. . . Lever, Upper Tape Guide	111797-001	1	7-1,1
. . . Mechanism Assembly	112346-001	1	7-1,8
. . . Readhead Assembly	114352-001	1	7-1,11
. . . Spring, Tape Guide	114372-001	1	7-1,15
. . . Tape Guide Assembly	114370-001	1	7-1,12
. . . Tape Guide Upper	112407-001	1	7-1,16
. . Sprocket, REMEX Specification	716057-102	1	7-1,7
. . Switch Housing Assembly	114463-001	1	7-4,1
. . . Bezel, Black, C&K 87888-2	715063-201	3	(S101-S103)
. . . Cap, ON/OFF, C&K 7922-1	715063-328	1	(S101)
. . . Cap, RUN/LOAD, C&K 7922-1	715063-331	1	(S101)
. . . Cap, ← / → , C&K 7922-1	715063-321	1	(S103)
. . . Connector, Housing, 6-Pin, Green Molex 09-50-7061	706510-222	1	7-2;P4
. . . Connector, Housing, 4-Pin, Molex 03-06-2042	706500-349	1	7-2;P102
. . . Contact, Connector, Molex 08-50-0106	706530-137	5	(P4)
. . . Contact, Connector, Molex 02-06-2103	706530-157	4	(P102)
. . . Housing, Panel Switches	113466-001	1	7-4;1
. . . Lug, Terminal, Amp 61454-1	715005-137	9	(S101-S103)
. . . Switch, ON-NONE-ON C&K L21Z3X36	715063-111	2	7-4;S101,S102
. . . Switch, (ON)-OFF-(ON), C&K 5205Z3BX36	715063-114	1	7-4;S103
. Kit of Parts See Table 1-1 for contents.	114466-001	1	
OPTIONS:			
Fanfold Kit (RMR0041)	113254-003	1	
. Backplate, Left	113253-001	1	
. Backplate, Right	113253-002	1	
. Deflector, Tape	110777-001	2	
. Filler Block	113609-001	1	
. Panel, Front, Fanfold	114472-001	1	
. Tank, Left	113610-002	1	
. Tank, Right	113610-001	1	
Manual (RMR0044)	112670-115	1	
Rear Cover Kit (RMR0042)	114476-001	1	
Desk Top Enclosure for reader with fanfold kit (RMR0045)	114517-001	1	

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM (IF PRESENT) AT THE REAR OF THE MANUAL FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Parts List, Printed Circuit Card Assembly 114321-003, -004

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
The following parts list was written for the E assembly and the D schematic revision. Subsequent changes are contained on a P.C. Card Change Record form contained in the addendum. The components for -003 and -004 are identical except as specifically noted.			
Bracket, Heatsink	114318-001	1	(Q12-Q15)
Capacitor, 0.01 µf, 100V, Ceramic Disk,	702121-103	35	C1-4,6,8,10, 12,18,19,22, 25 - 28,30,32, 33,35,41-47, 51-56,58,60, 62
Capacitor, 100pf, 200V, Ceramic, Type CK05	702128-101	2	C5,C61
Capacitor, 0.056 µf, 100V, Metallized Mylar, Electrocube 217A1B563K	702181-563	1	C7
Capacitor, 0.1 µf, 100V, Metallized Mylar, IMB XP7B104X	702181-104	4	C9,C11,C36
Capacitor, 1 µf, 50V, Ceramic, Monolythic, Sprague Type 7C	702131-105	6	C13-C16,C23, C24
Capacitor, 0.001 µf, 200V, Ceramic, Type CK05	702128-102	3	C17,C34,C49
Capacitor, 0.15 µf, 100V, Metallized Mylar Electrocube 217A1B154K	702181-154	1	C20
Capacitor, 0.01 µf, 100V, Metallized Mylar IMB XP7B103X	702181-103	1	C21
Capacitor, 33 µf, 10V, Tantalex Sprague 196D336X9010KA1	702393-336	2	C29,C31
Capacitor, 0.1 µf, 100V, Ceramic Disk Sprague Type TG	702121-104	1	C50
Capacitor, 10 µf, 25V, Polarized, Solid Tantalum Sprague 196D106X9025KA1	702395-106	1	C57
Capacitor, 3.3 µf, 15V, Polarized, Solid Tantalum Sprague 196D336X9015HA1	702394-335	1	C59
Connector, Cannon DB-25PV	706500-239	1	J1
Connector, 15-Pin, Green, Molex 09-60-1151	706501-155	1	J2
Connector, 6-Pin, Green, Molex 09-60-1061	706501-065	1	J4
Connector, 6-Pin, Yellow, Molex 09-60-1061	706501-064	1	J5
Connector, 3-Pin, White Molex 09-60-1031	706501-039	1	J8
Diode, IN4003	704005-137	4	CR1,CR3-CR5
Diode, IN276	704000-100	1	CR2
Heat Sink, IERE PB1-2CB	715033-135	1	(Z34)

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM (IF PRESENT) AT THE REAR OF THE MANUAL FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Parts List, Printed Circuit Card Assembly 114321-003, -004 (Continued)

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
I.C. Package, 74C14	704800-106	2	Z1,Z5
I.C. Package, 4050	704800-115	2	Z2,Z9
I.C. Package, 7486	704600-109	3	Z3,Z4,Z25
I.C. Package, 74LS75	704620-075	2	Z6,Z7
I.C. Package, 7404	704600-110	1	Z8
I.C. Package, Resistor, Capacitor Network REMEX Specification	701950-007	1	Z10
I.C. Package, 74LS132	704620-132	1	Z11
I.C. Package, 74LS00	704620-000	5	Z12,Z13,Z18, Z19,Z22
I.C. Package, 74LS08	704620-008	4	Z14,Z16,Z20, Z29
I.C. Package, 74LS221	704620-221	4	Z15,Z23,Z24, Z26
I.C. Package, 74LS123	704620-123	1	Z17
I.C. Package, 74LS74	704620-074	2	Z21,Z28
I.C. Package, 74LS03	704620-003	1	Z27
I.C. Package, VR7812	704520-119	1	Z33
I.C. Package, VR7805	704520-120	1	Z34
I.C. Package, VR7912	704520-126	1	Z35
Insulator	715019-120	1	(Z33)
Resistor, 2.7K, 1/4W, ± 5%	701003-272	9	R2,4,6,8,10, 12,14,16,18
Resistor, 196 ohm, 1/4W, ± 1%	701211-960	1	R20
Resistor, 12.1K, 1/4W, ± 1%	701211-212	1	R21
Resistor, 3.16K, 1/4W, ± 1%	701213-161	1	R22
Resistor, 6.81K, 1/4W, ± 1%	701216-811	1	R23
Resistor, 8.2K, 1/4W, ± 5%	701003-822	3	R25,R28,R71
Resistor, 10K, 1/4W, ± 5%	701003-103	2	R26,R85
Resistor, 22 ohm, 1/4W, ± 5%	701003-220	3	R27,R40,R41
Resistor, 22K, 1/4W, ± 5%	701003-223	2	R30,R43
Resistor, 1K, 1/4W, ± 5%	701003-102	7	R31,R32 ①,R35, R44,R47,R54, R68
Resistor, 4.7K, 1/4W, ± 5%	701003-472	1	R33 ①
Resistor, 35 ohm, 10W	701017-350	1	R34 ①
Resistor, 47 ohm, 1/4W, ± 5%	701003-470	3	R36,R39,R50
Resistor, 2.2K, 1/4W, ± 5%	701003-222	4	R37,R38,R51, R67
Resistor, 7.32K, 1/4W, ± 1%	701217-321	1	R42
Resistor, 330 ohm, 1/4W, ± 5%	701003-331	3	R45,R46,R52
Resistor, 47K, 1/4W, ± 5%	701003-473	1	R48
Resistor, 27K, 1/4W, ± 5%	701003-273	1	R49
Resistor, 10 ohm, 1/4W, ± 5%	701003-100	1	R66

① -004 Assembly Only

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM (IF PRESENT) AT THE REAR OF THE MANUAL FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Parts List, Printed Circuit Card Assembly 114321-003, -004 (Continued)

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Resistor, 20K, 1/4W, ± 5%	701003-203	1	R70
Resistor, Variable, 25k, 1/2W, Bourns 3355X-1-253	701653-253	11	R1,3,5,7,9,11 13,15,17,24, 29
Screw Lock Assembly, Set of 2, Female, Cannon D-10418-2	706540-123	1	(J1)
Standoff, Cambion 350-7409-10-19	715030-170	19	TP1-TP11,TP16-TP19,TP +12V, - 12V
Transistor, MPSU05	704204-130	1	Q1 ①
Transistor, MPSA06	704203-118	1	Q2 ①
Transistor, MJE1090	704212-108	1	Q3
Transistor, MJE1100	704204-115	3	Q4,Q5,Q6

①-004 Assembly Only

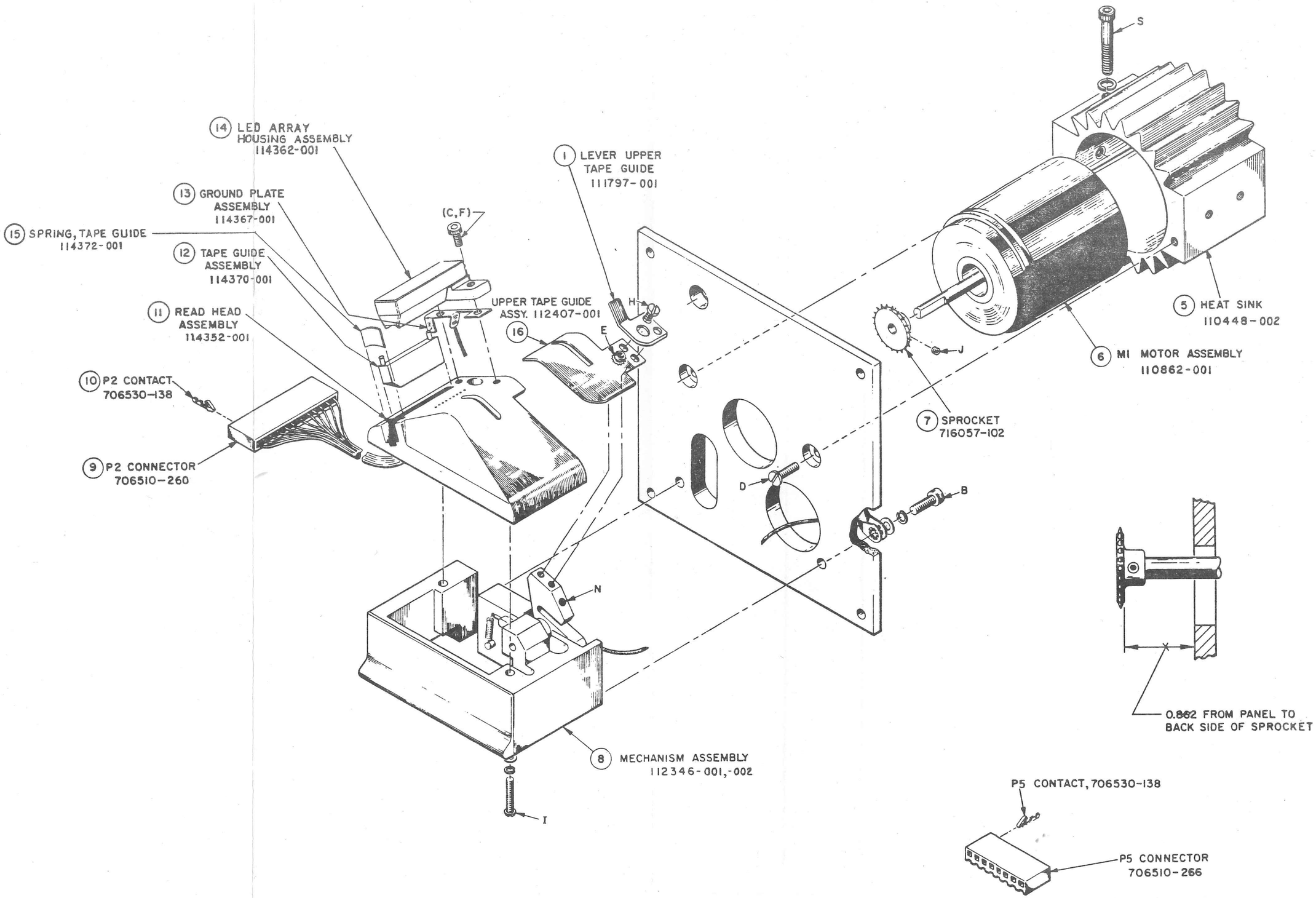


Figure 7-1. Readhead Mechanism and Step Motor Assembly Exploded View.

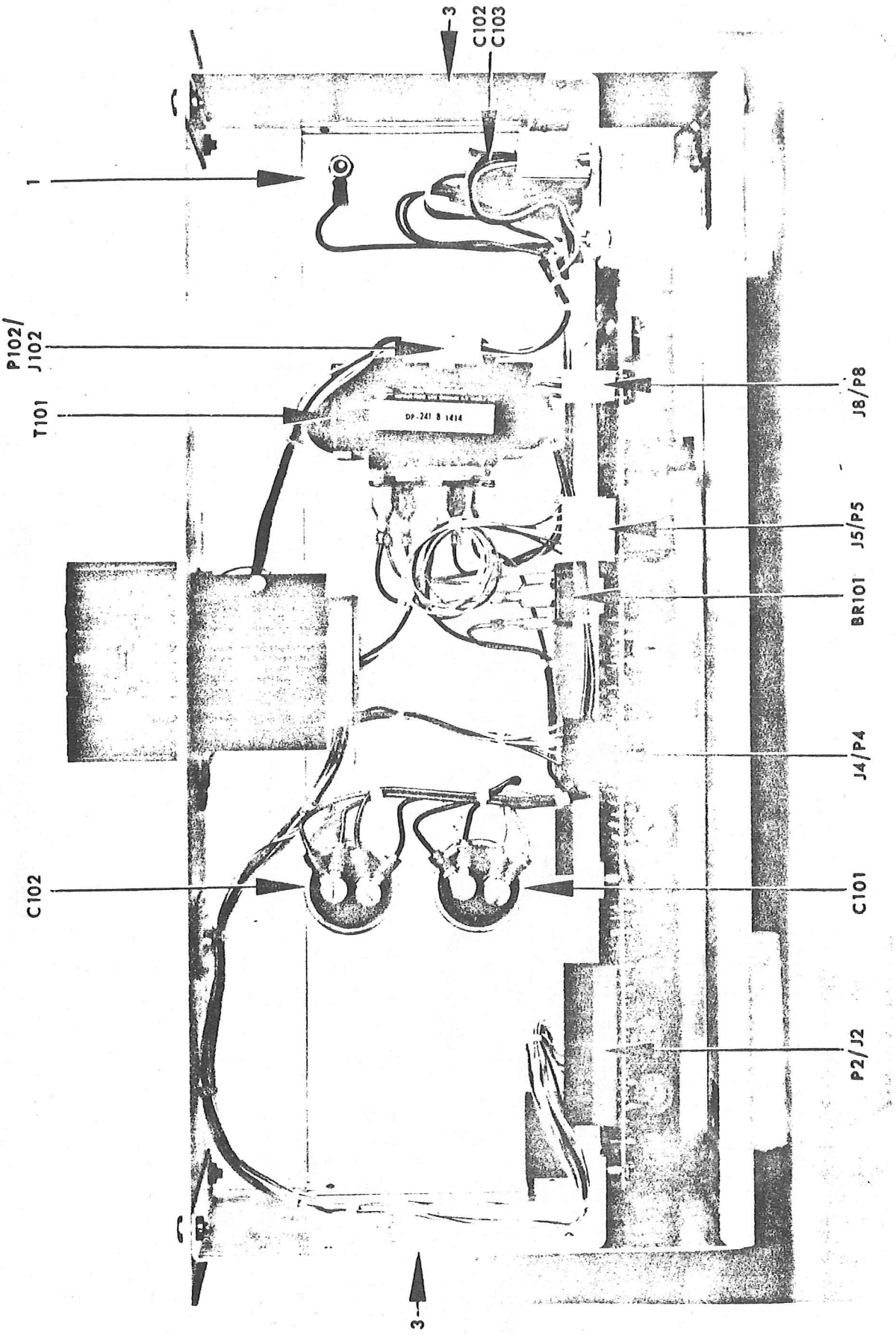


Figure 7-2. Top View, RR-7155BA1, Showing Chassis Assembly.

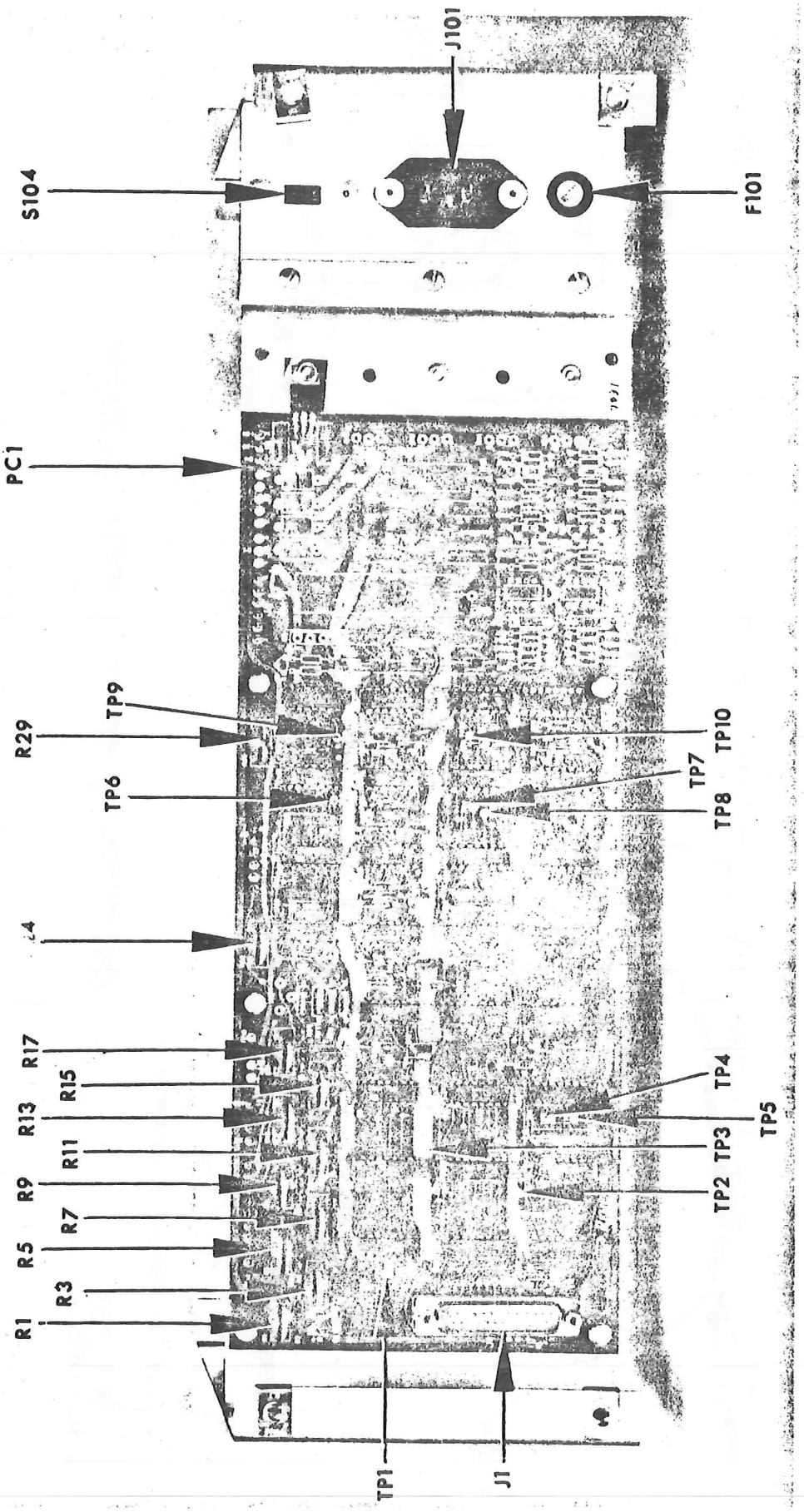


Figure 7-3. Rear View, RR-7155BA1.

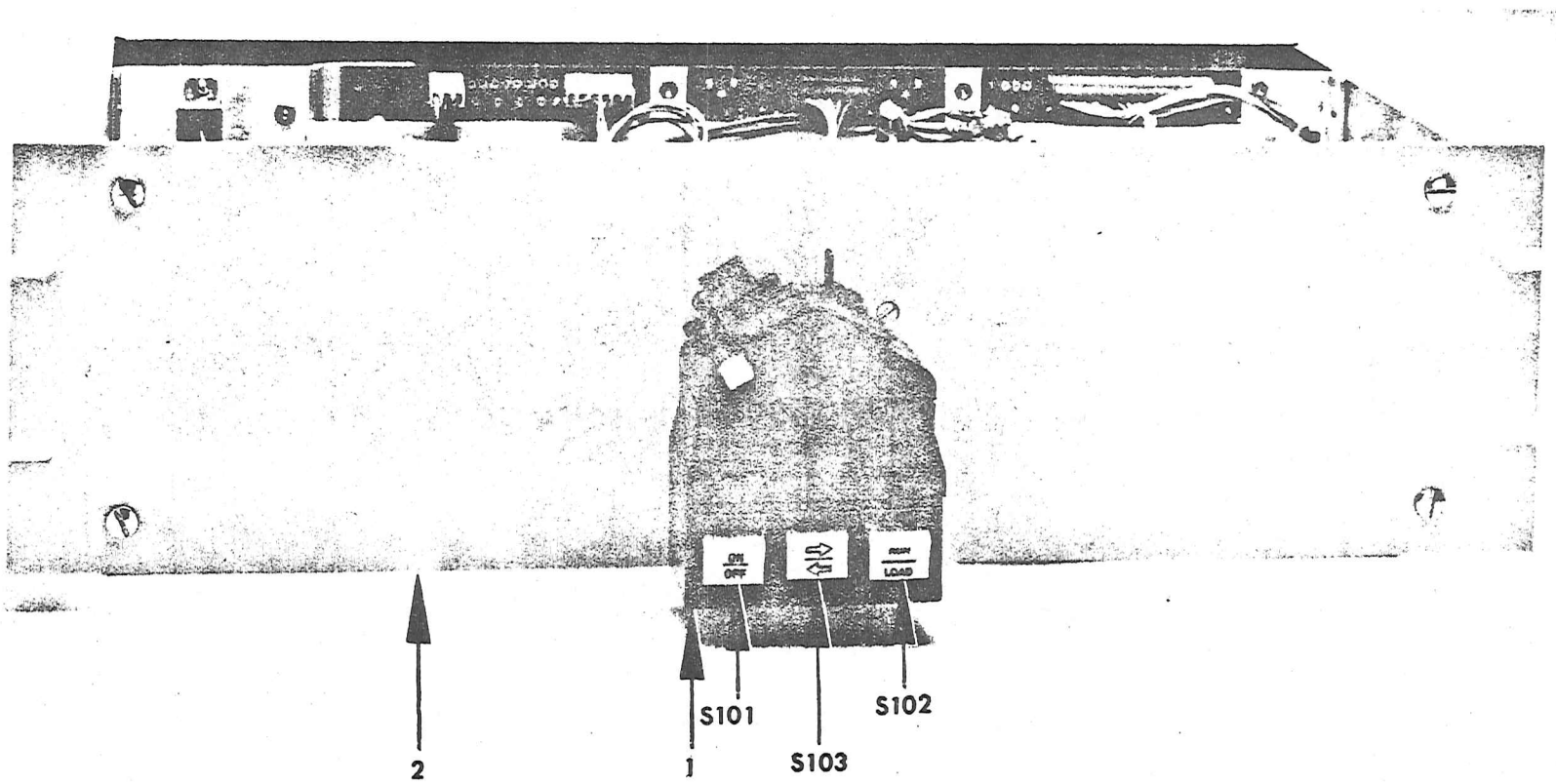


Figure 7-4. Front View, RR-7155BA1.

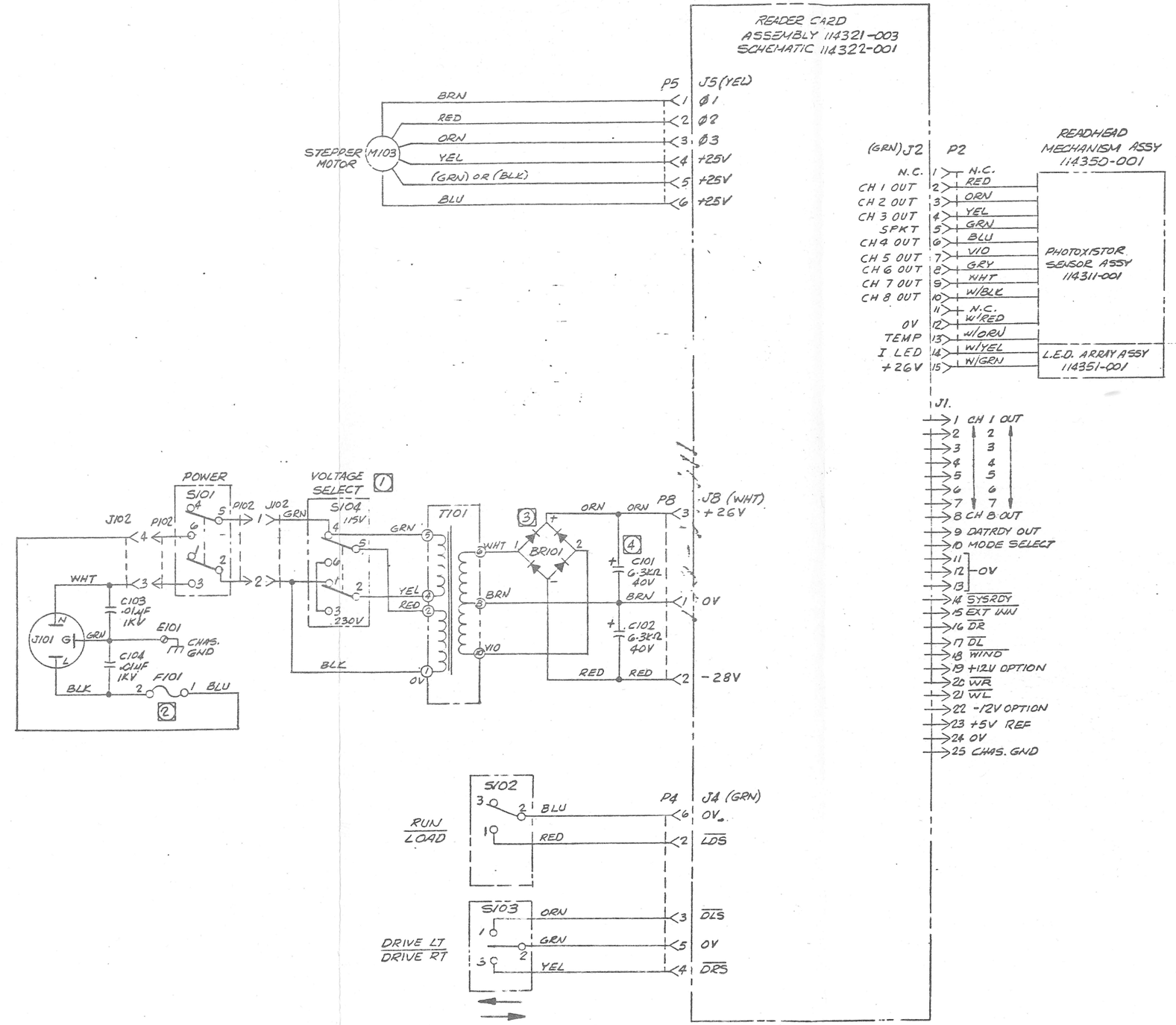
SECTION VIII

SCHEMATIC DRAWINGS

8.1 GENERAL

Figure 8-1 contains the system schematic for the RR-7155BA1/660 and Figure 8-2 gives the schematic for the Reader Card 114321-003 and -004.

SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPRD
A	—	1.15.79	RELEASED	C.P.	1.15.79	
B	19055	6.20.80	J1-19 WAS NC, J1-20 WAS NC, J1-21 WAS +12V OPTION	DG.M.	6.20.80	



NOTES: UNLESS OTHERWISE SPECIFIED.
1. S104 SHOWN IN 115VAC SELECT MODE.
2. F101 IS 1.0AMP SLO-BLO FOR 115V OPERATION. FOR 230 V OPERATION – USE 0.5A.
3. BRI01 IS 704005-143.
4. C101 & C102 ARE 702313-108.
5. REF. FINAL ASSY DWG. NO. 814470-001

Figure 8-1

SYSTEM SCHEMATIC
RR-7155BA1/
8-3/8-4

- NOTICE -
THIS DRAWING IS THE PROPERTY OF REMEX A UNIT OF EXCELL D CORPORATION AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN IN WHICH REMEX RETAINS ALL PATENT AND OTHER RIGHTS INCLUDING EXCLUSIVE RIGHT OF USE, MANUFACTURE AND SALE. IT IS SUBMITTED UNDER A CONFIDENTIAL RELATIONSHIP FOR A SPECIFIC PURPOSE AND THE RECIPIENT AGREES BY ACCEPTING THIS DRAWING NOT TO SUPPLY OR DISCLOSE ANY INFORMATION REGARDING IT TO ANY UNAUTHORIZED PERSON.

REMEX 1733 ALTON STREET IRVINE CALIF 92714

DWG No 114464-001 REV B

DR PROSSV | CHK [illegible] 1.15.79 | APP [illegible] 1.16.79 | SHEET 1 OF 1

FORM NO. ED631-612

DESIGNATION	LAST USED	NOT USED
CAPACITOR	C107	
DIODE	CR5	
INTEGRATED CKT	Z36	Z30
RESISTOR	R85	R27
TRANSISTOR	Q15	
CHOKE	L4	
TEST POINT	TP19	TP12-15

REVISION STATUS		
ECO	SCH	ASSY
A	A	A
B	B	B
C	C	C
D	D	D
E	D'	E
F	E'	E1
G	E	E2
H	F	F
J	F1	G
K	G	G

SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPD
A	9000	6-14-71	ORIGINAL RELEASE			
B	9000	6-14-71	ADDED REV STATUS BLOCK			
C	9000	6-14-71	SEE ECO			
D	9000	6-14-71	SHT 1 TOOLING HOLE WAS .156 DIA			
E	9000	6-14-71	UPDATED REV STATUS BLOCK			
F	9000	6-14-71	ADDED SHT 5			
G	9000	6-14-71	ADDED SHT 5			
H	9000	6-14-71	ADDED SHT 5			
J	9000	6-14-71	ADDED SHT 5			
K	9000	6-14-71	ADDED SHT 5			
L	9000	6-14-71	UPDATED REV STATUS BLOCK			
M	9000	6-14-71	ADDED SHT 5			
N	9000	6-14-71	ADDED SHT 5			
P	9000	6-14-71	ADDED SHT 5			
R	9000	6-14-71	ADDED SHT 5			
S	9000	6-14-71	ADDED SHT 5			
T	9000	6-14-71	ADDED SHT 5			
U	9000	6-14-71	ADDED SHT 5			
V	9000	6-14-71	ADDED SHT 5			
W	9000	6-14-71	ADDED SHT 5			
X	9000	6-14-71	ADDED SHT 5			
Y	9000	6-14-71	ADDED SHT 5			
Z	9000	6-14-71	ADDED SHT 5			
AA	9000	6-14-71	ADDED SHT 5			
AB	9000	6-14-71	ADDED SHT 5			
AC	9000	6-14-71	ADDED SHT 5			
AD	9000	6-14-71	ADDED SHT 5			
AE	9000	6-14-71	ADDED SHT 5			
AF	9000	6-14-71	ADDED SHT 5			
AG	9000	6-14-71	ADDED SHT 5			
AH	9000	6-14-71	ADDED SHT 5			
AJ	9000	6-14-71	ADDED SHT 5			
AK	9000	6-14-71	ADDED SHT 5			
AL	9000	6-14-71	ADDED SHT 5			
AM	9000	6-14-71	ADDED SHT 5			
AN	9000	6-14-71	ADDED SHT 5			
AP	9000	6-14-71	ADDED SHT 5			
AR	9000	6-14-71	ADDED SHT 5			
AS	9000	6-14-71	ADDED SHT 5			
AT	9000	6-14-71	ADDED SHT 5			
AU	9000	6-14-71	ADDED SHT 5			
AV	9000	6-14-71	ADDED SHT 5			
AW	9000	6-14-71	ADDED SHT 5			
AX	9000	6-14-71	ADDED SHT 5			
AY	9000	6-14-71	ADDED SHT 5			
AZ	9000	6-14-71	ADDED SHT 5			
BA	9000	6-14-71	ADDED SHT 5			
BB	9000	6-14-71	ADDED SHT 5			
BC	9000	6-14-71	ADDED SHT 5			
BD	9000	6-14-71	ADDED SHT 5			
BE	9000	6-14-71	ADDED SHT 5			
BF	9000	6-14-71	ADDED SHT 5			
BG	9000	6-14-71	ADDED SHT 5			
BH	9000	6-14-71	ADDED SHT 5			
BJ	9000	6-14-71	ADDED SHT 5			
BK	9000	6-14-71	ADDED SHT 5			
BL	9000	6-14-71	ADDED SHT 5			
BM	9000	6-14-71	ADDED SHT 5			
BN	9000	6-14-71	ADDED SHT 5			
BP	9000	6-14-71	ADDED SHT 5			
BR	9000	6-14-71	ADDED SHT 5			
BS	9000	6-14-71	ADDED SHT 5			
BT	9000	6-14-71	ADDED SHT 5			
BU	9000	6-14-71	ADDED SHT 5			
BV	9000	6-14-71	ADDED SHT 5			
BW	9000	6-14-71	ADDED SHT 5			
BX	9000	6-14-71	ADDED SHT 5			
BY	9000	6-14-71	ADDED SHT 5			
BZ	9000	6-14-71	ADDED SHT 5			
CA	9000	6-14-71	ADDED SHT 5			
CB	9000	6-14-71	ADDED SHT 5			
CC	9000	6-14-71	ADDED SHT 5			
CD	9000	6-14-71	ADDED SHT 5			
CE	9000	6-14-71	ADDED SHT 5			
CF	9000	6-14-71	ADDED SHT 5			
CG	9000	6-14-71	ADDED SHT 5			
CH	9000	6-14-71	ADDED SHT 5			
CJ	9000	6-14-71	ADDED SHT 5			
CK	9000	6-14-71	ADDED SHT 5			
CL	9000	6-14-71	ADDED SHT 5			
CM	9000	6-14-71	ADDED SHT 5			
CN	9000	6-14-71	ADDED SHT 5			
CP	9000	6-14-71	ADDED SHT 5			
CR	9000	6-14-71	ADDED SHT 5			
CS	9000	6-14-71	ADDED SHT 5			
CT	9000	6-14-71	ADDED SHT 5			
CU	9000	6-14-71	ADDED SHT 5			
CV	9000	6-14-71	ADDED SHT 5			
CW	9000	6-14-71	ADDED SHT 5			
CX	9000	6-14-71	ADDED SHT 5			
CY	9000	6-14-71	ADDED SHT 5			
CZ	9000	6-14-71	ADDED SHT 5			
DA	9000	6-14-71	ADDED SHT 5			
DB	9000	6-14-71	ADDED SHT 5			
DC	9000	6-14-71	ADDED SHT 5			
DD	9000	6-14-71	ADDED SHT 5			
DE	9000	6-14-71	ADDED SHT 5			
DF	9000	6-14-71	ADDED SHT 5			
DG	9000	6-14-71	ADDED SHT 5			
DH	9000	6-14-71	ADDED SHT 5			
DJ	9000	6-14-71	ADDED SHT 5			
DK	9000	6-14-71	ADDED SHT 5			
DL	9000	6-14-71	ADDED SHT 5			
DM	9000	6-14-71	ADDED SHT 5			
DN	9000	6-14-71	ADDED SHT 5			
DP	9000	6-14-71	ADDED SHT 5			
DR	9000	6-14-71	ADDED SHT 5			
DS	9000	6-14-71	ADDED SHT 5			
DT	9000	6-14-71	ADDED SHT 5			
DU	9000	6-14-71	ADDED SHT 5			
DV	9000	6-14-71	ADDED SHT 5			
DW	9000	6-14-71	ADDED SHT 5			
DX	9000	6-14-71	ADDED SHT 5			
DY	9000	6-14-71	ADDED SHT 5			
DZ	9000	6-14-71	ADDED SHT 5			
EA	9000	6-14-71	ADDED SHT 5			
EB	9000	6-14-71	ADDED SHT 5			
EC	9000	6-14-71	ADDED SHT 5			
ED	9000	6-14-71	ADDED SHT 5			
EE	9000	6-14-71	ADDED SHT 5			
EF	9000	6-14-71	ADDED SHT 5			
EG	9000	6-14-71	ADDED SHT 5			
EH	9000	6-14-71	ADDED SHT 5			
EJ	9000	6-14-71	ADDED SHT 5			
EK	9000	6-14-71	ADDED SHT 5			
EL	9000	6-14-71	ADDED SHT 5			
EM	9000	6-14-71	ADDED SHT 5			
EN	9000	6-14-71	ADDED SHT 5			
EP	9000	6-14-71	ADDED SHT 5			
ER	9000	6-14-71	ADDED SHT 5			
ES	9000	6-14-71	ADDED SHT 5			
ET	9000	6-14-71	ADDED SHT 5			
EU	9000	6-14-71	ADDED SHT 5			
EV	9000	6-14-71	ADDED SHT 5			
EW	9000	6-14-71	ADDED SHT 5			
EX	9000	6-14-71	ADDED SHT 5			
EY	9000	6-14-71	ADDED SHT 5			
EZ	9000	6-14-71	ADDED SHT 5			
FA	9000	6-14-71	ADDED SHT 5			
FB	9000	6-14-71	ADDED SHT 5			
FC	9000	6-14-71	ADDED SHT 5			
FD	9000	6-14-71	ADDED SHT 5			
FE	9000	6-14-71	ADDED SHT 5			
FF	9000	6-14-71	ADDED SHT 5			
FG	9000	6-14-71	ADDED SHT 5			
FH	9000	6-14-71	ADDED SHT 5			
FJ	9000	6-14-71	ADDED SHT 5			
FK	9000	6-14-71	ADDED SHT 5			
FL	9000	6-14-71	ADDED SHT 5			
FM	9000	6-14-71	ADDED SHT 5			
FN	9000	6-14-71	ADDED SHT 5			
FP	9000	6-14-71	ADDED SHT 5			
FR	9000	6-14-71	ADDED SHT 5			
FS	9000	6-14-71	ADDED SHT 5			
FT	9000	6-14-71	ADDED SHT 5			
FU	9000	6-14-71	ADDED SHT 5			
FV	9000	6-14-71	ADDED SHT 5			
FW	9000	6-14-71	ADDED SHT 5			
FX	9000	6-14-71	ADDED SHT 5			
FY	9000	6-14-71	ADDED SHT 5			
FZ	9000	6-14-71	ADDED SHT 5			
GA	9000	6-14-71	ADDED SHT 5			
GB	9000	6-14-71	ADDED SHT 5			
GC	9000	6-14-71	ADDED SHT 5			
GD	9000	6-14-71	ADDED SHT 5			
GE	9000	6-14-71	ADDED SHT 5			
GF	9000	6-14-71	ADDED SHT 5			
GG	9000	6-14-71	ADDED SHT 5			
GH	9000	6-14-71	ADDED SHT 5			
GJ	9000	6-14-71	ADDED SHT 5			
GK	9000	6-14-71	ADDED SHT 5			
GL	9000	6-14-71	ADDED SHT 5			
GM	9000	6-14-71	ADDED SHT 5			
GN	9000	6-14-71	ADDED SHT 5			
GP	9000	6-14-71	ADDED SHT 5			
GR	9000	6-14-71	ADDED SHT 5			
GS	9000	6-14-71	ADDED SHT 5			
GT	9000	6-14-71	ADDED SHT 5			
GU	9000	6-14-71	ADDED SHT 5			
GV	9000	6-14-71	ADDED SHT 5			
GW	9000	6-14-71	ADDED SHT 5			
GX	9000	6-14-71	ADDED SHT 5			
GY	9000	6-14-71	ADDED SHT 5			
GZ	9000	6-14-71	ADDED SHT 5			
HA	9000	6-14-71	ADDED SHT 5			
HB	9000	6-14-71	ADDED SHT 5			
HC	9000	6-14-71	ADDED SHT 5			
HD	9000	6-14-71	ADDED SHT 5			
HE	9000	6-14-71	ADDED SHT 5			
HF	9000	6-14-71	ADDED SHT 5			
HG	9000	6-14-71	ADDED SHT 5			
HH	9000	6-14-71	ADDED SHT 5			
HJ	9000	6-14-71	ADDED SHT 5			
HK	9000	6-14-71	ADDED SHT 5			
HL	9000	6-14-71	ADDED SHT 5			
HM	9000	6-14-71	ADDED SHT 5			
HN	9000	6-14-71	ADDED SHT 5			
HP	9000	6-14-71	ADDED SHT 5			
HR	9000	6-14-71	ADDED SHT 5			
HS	9000	6-14-71	ADDED SHT 5			
HT	9000	6-14-71	ADDED SHT 5			
HU	9000	6-14-71	ADDED SHT 5			
HV	9000	6-14-71	ADDED SHT 5			
HW	9000	6-14-71	ADDED SHT 5			
HX	9000	6-14-71	ADDED SHT 5			
HY	9000	6-14-71	ADDED SHT 5			
HZ	9000	6-14-71	ADDED SHT 5			
JA	9000	6-14-71	ADDED SHT 5			
JB	9000	6-14-71	ADDED SHT 5			
JC	9000	6-14-71	ADDED SHT 5			
JD	9000	6-14-71	ADDED SHT 5			
JE	9000	6-14-71	ADDED SHT 5			
JF	9000	6-14-71	ADDED SHT 5			
JG	9000	6-14-71	ADDED SHT 5			
JH	9000	6-14-71	ADDED SHT 5			
JJ	9000	6-14-71	ADDED SHT 5			
JK	9000	6-14-71	ADDED SHT 5			
JL	9000	6-14-71	ADDED SHT 5			
JM	9000	6-14-71	ADDED SHT 5			
JN	9000	6-14-71	ADDED SHT 5			
JP	9000	6-14-71	ADDED SHT 5			
JR	9000	6-14-71	ADDED SHT 5			
JS	9000	6-14-71	ADDED SHT 5			
JT	9000	6-14-71	ADDED SHT 5			
JU	9000	6-14-71	ADDED SHT 5			
JV	9000	6-14-71	ADDED SHT 5			
JW	9000	6-14-71	ADDED SHT 5			
JX	9000	6-14-71	ADDED SHT 5			
JY	9000	6-14-71	ADDED SHT 5			
JZ	9000	6-14-71	ADDED SHT 5			
KA	9000	6-14-71	ADDED SHT 5			
KB	9000	6-14-71	ADDED SHT 5			
KC	9000	6-14-71	ADDED SHT 5			
KD	9000	6-14-71	ADDED SHT 5			
KE	9000	6-14-71	ADDED SHT 5			
KF	9000	6-14-71	ADDED SHT 5			
KG	9000	6-14-71	ADDED SHT 5			
KH	9000	6-14-71	ADDED SHT 5			
KJ	9000	6-14-71	ADDED SHT 5			
KK	9000	6-14-71	ADDED SHT 5			
KL	9000	6-14-71	ADDED SHT 5			
KM	9000	6-14-71	ADDED SHT 5			
KN	9000	6-14-71	ADDED SHT 5			
KP	9000	6-14-71	ADDED SHT 5			
KR	9000	6-14-71	ADDED SHT 5			
KS	9000	6-14-71	ADDED SHT 5			
KT	9000	6-14-71	ADDED SHT 5			
KU	9000	6-14-71	ADDED SHT 5			
KV	9000	6-14-71	ADDED SHT 5			
KW	9000	6-14-71	ADDED SHT 5			
KX	9000	6-14-71	ADDED SHT 5			
KY	9000	6-14-71	ADDED SHT 5			
KZ	9000	6-14-71	ADDED SHT 5			
LA	9000	6-14-71	ADDED SHT 5			
LB	9000	6-14-71	ADDED SHT 5			
LC	9000	6-14-71	ADDED SHT 5			
LD	9000	6-14-71	ADDED SHT 5			
LE	9000	6-14-71	ADDED SHT 5			
LF	9000	6-14-71	ADDED SHT 5			
LG	9000	6-14-71	ADDED SHT 5			
LH	9000	6-14-71	ADDED SHT 5			
LJ	9000	6-14-71	ADDED SHT 5			
LK	9000	6-14-71	ADDED SHT 5			
LL	9000	6-14-71	ADDED SHT 5			
LM	9000	6-14-71	ADDED SHT 5			
LN	9000	6-14-71	ADDED SHT 5			
LP	9000	6-14-71	ADDED SHT 5			
LR	9000	6-14-71	ADDED SHT 5			
LS	9000	6-14-71	ADDED SHT 5			
LT	9000	6-14-71	ADDED SHT 5			
LU	9000	6-14-71	ADDED SHT 5			
LV	9000	6-14-71	ADDED SHT 5			
LW	9000	6-14-71	ADDED SHT 5			
LX	9000	6-14-71	ADDED SHT 5			
LY	9000	6-14-71	ADDED SHT 5			
LZ	9000	6-14-71	ADDED SHT 5			
MA	9000	6-14-71	ADDED SHT 5			
MB	9000	6-14-71	ADDED SHT 5			
MC	9000	6-14-71	ADDED SHT 5			
MD	9000	6-14-71	ADDED SHT 5			
ME	9000	6-14-71	ADDED SHT 5			
MF	9000	6-14-71	ADDED SHT 5			
MG	9000	6-14-71	ADDED SHT 5			
MH	9000	6-14-71	ADDED SHT 5			
MJ	9000	6-14-71	ADDED SHT 5			
MK	9000	6-14-71	ADDED SHT 5			
ML	9000	6-14-71	ADDED SHT 5			
MM	9000	6-14-71	ADDED SHT 5			
MN	9000	6-14-71	ADDED SHT 5			
MP	9000	6-14-71	ADDED SHT 5			
MR	9000	6-14-71	ADDED SHT 5			
MS	9000	6-14-71	ADDED SHT 5			
MT	9000	6-14-71	ADDED SHT 5			
MU	9000	6-14-71	ADDED SHT 5			
MV	9000	6-14-71	ADDED SHT 5			
MW	9000	6-14-71	ADDED SHT 5			
MX	9000	6-14-71	ADDED SHT 5			
MY	9000	6-14-71	ADDED SHT 5			
MZ	9000	6-14-71	ADDED SHT 5			
NA	9000	6-14-71	ADDED SHT 5			
NB	9000	6-14-71	ADDED SHT 5			
NC	9000	6-14-71	ADDED SHT 5			
ND	9000	6-14-71	ADDED SHT 5			
NE	9000	6-14-71	ADDED SHT 5			
NF	9000	6-14-71	ADDED SHT 5			
NG	9000	6-14-71	ADDED SHT 5			
NH	9000	6-14-71	ADDED SHT 5			
NJ	9000	6-14-71	ADDED SHT 5			
NK	9000	6-14-71	ADDED SHT 5			
NL	9000	6-14-71	ADDED SHT 5			
NM	9000	6-14-71	ADDED SHT 5			
NN	9000	6-14-71	ADDED SHT 5			
NP	9000	6-14-71	ADDED SHT 5			
NR	9000	6-14-71	ADDED SHT 5			
NS	9000	6-14-71	ADDED SHT 5			
NT	9000	6-14-71	ADDED SHT 5			
NU	9000	6-14-71	ADDED SHT 5			
NV	9000	6-14-71	ADDED SHT 5			
NW	9000	6-14-71	ADDED SHT 5			
NX	9000	6-14-71	ADDED SHT 5			
NY	9000	6-14-71	ADDED SHT 5			
NZ	9000	6-14-71	ADDED SHT 5			
PA	9000	6-14-71	ADDED SHT 5			
PB	9000	6-14-71	ADDED SHT 5			
PC	9000	6-14-71	ADDED SHT 5			
PD	9000	6-14-71	ADDED SHT 5			
PE	9000	6-14-71	ADDED SHT 5			
PF	9000	6-14-71	ADDED SHT 5			
PG	9000	6-14-71	ADDED SHT 5			
PH	9000	6-14-71	ADDED SHT 5			
PJ	9000	6-14-71	ADDED SHT 5			
PK	9000	6-14-71	ADDED SHT 5			
PL	9000	6-14-71	ADDED SHT 5			
PM	9000	6-14-71	ADDED SHT 5			
PN	9000	6-14-71	ADDED SHT 5			
PP	9000	6-14-71	ADDED SHT 5			
PR	9000	6-14-71	ADDED SHT 5			
PS	9000	6-14-71	ADDED SHT 5			
PT	9000	6-14-71	ADDED SHT 5			
PU	9000	6-14-71	ADDED SHT 5			
PV	9000	6-14-71	ADDED SHT 5			
PW	9000	6-14-71	ADDED SHT 5			
PX	9000	6-14-71	ADDED SHT 5			
PY	9000	6-14-71	ADDED SHT 5			
PZ	9000	6-14-71	ADDED SHT 5			
QA	9000	6-14-71	ADDED SHT 5			
QB	9000	6-14-71	ADDED SHT 5			
QC	9000	6-14-71	ADDED SHT 5			
QD	9000	6-14-71	ADDED SHT 5			
QE	9000	6-14-71	ADDED SHT 5			
QF	9000	6-14-71	ADDED SHT 5			
QG	9000	6-14-71	ADDED SHT 5			
QH	9000	6-14-71	ADDED SHT 5			
QJ	9000	6-14-71	ADDED SHT 5			
QK	9000	6-14-71	ADDED SHT 5			
QL	9000	6-14-71	ADDED SHT 5			
QM	9000	6-14-71	ADDED SHT 5			
QN	9000	6-14-71	ADDED SHT 5			
QP	9000	6-14-71	ADDED SHT 5			
QR	9000	6-14-71	ADDED SHT 5			
QS	9000	6-14-71	ADDED SHT 5			
QT	9000	6-14-71	ADDED SHT 5			
QU	9000	6-14-71	ADDED SHT 5			
QV	9000	6-14-71	ADDED SHT 5			
QW	9000	6-14-71	ADDED SHT 5			
QX	9000	6-14-71	ADDED SHT 5			
QY	9000	6-14-71	ADDED SHT 5			
QZ	9000	6-14-71	ADDED SHT 5			
RA	9000	6-14-71	ADDED SHT 5			
RB	9000	6-14-71	ADDED SHT 5			
RC	9000	6-14-71	ADDED SHT 5			
RD	9000	6-14-71	ADDED SHT 5			
RE	9000	6-14-71	ADDED SHT 5			
RF	9000	6-14-71	ADDED SHT 5			
RG	9000	6-14-71	ADDED SHT 5			
RH	9000	6-14-71	ADDED SHT 5			
RJ	9000	6-14-71	ADDED SHT 5			
RK	9000	6-14-71	ADDED SHT 5			
RL	9000	6-14-71	ADDED SHT 5			
RM	9000	6-14-71	ADDED SHT 5			
RN	9000	6-14-71	ADDED SHT 5			
RP	9000	6-14-71	ADDED SHT 5			
RR	9000	6-14-71	ADDED SHT 5			
RS	9000	6-14-71	ADDED SHT 5			
RT	9000	6-14-71	ADDED SHT 5			
RU	9000	6-14-71	ADDED SHT 5			
RV	9000	6-14-71	ADDED SHT 5			
RW	9000	6-14-71	ADDED SHT 5			
RX	9000	6-14-71	ADDED SHT 5			
RY	9000	6-14-71	ADDED SHT 5			
RZ	9000	6-14-71	ADDED SHT 5			
SA	9000	6-14-71	ADDED SHT 5			
SB	9000	6-14-71	ADDED SHT 5			
SC	9000	6-14-71	ADDED SHT 5			
SD	9000	6-14-71	ADDED SHT 5			
SE	9000	6-14-71	ADDED SHT 5			
SF	9000	6-14-71	ADDED SHT 5			
SG	9000	6-14-71	ADDED SHT 5			
SH	9000	6-14-71	ADDED SHT 5			
SJ	9000	6-14-71	ADDED SHT 5			
SK	9000	6-14-71	ADDED SHT 5			
SL	9000	6-14-71	ADDED SHT 5			
SM	9000	6-14-71	ADDED SHT 5			
SN	9000	6-14-71	ADDED SHT 5			
SP	9000	6-14-71	ADDED SHT 5			
SR	9000	6-14-71	ADDED SHT 5			
SS	9000	6-14-71	ADDED SHT 5			
ST	9000	6-14-71	ADDED SHT 5			
SU	9000	6-14-71	ADDED SHT 5			
SV	9000	6-14-71	ADDED SHT 5			
SW	9000	6-14-71	ADDED SHT 5			
SX	9000	6-14-71	ADDED SHT 5			
SY	9000	6-14-71	ADDED SHT 5			
SZ	9000	6-14-71	ADDED SHT 5			
TA	9000	6-14-71	ADDED SHT 5			
TB	9000	6-14-71	ADDED SHT 5			
TC	9000	6-14-71	ADDED SHT 5			
TD	9000	6-14-71	ADDED SHT 5			
TE	9000	6-14-71	ADDED SHT 5			
TF	9000	6-14-71	ADDED SHT 5			
TG	9000	6-14-71	ADDED SHT 5			
TH	9000	6-14-71	ADDED SHT 5			
TJ	9000	6-14-71	ADDED SHT 5			
TK	9000	6-14-71	ADDED SHT 5			
TL	9000	6-14-71	ADDED SHT 5			
TM	9000	6-14-71	ADDED SHT 5			
TN	9000	6-14-71	ADDED SHT 5			
TP	9000	6-14-71	ADDED SHT 5			
TR	9000	6-14-71	ADDED SHT 5			
TS	9000	6-14-71	ADDED SHT 5			
TT	9000	6-14-71	ADDED SHT 5			
TU	9000	6-14-71	ADDED SHT 5			
TV	9000	6-14-71	ADDED SHT 5			
TW	9000	6-14-71	ADDED SHT 5			
TX	9000	6-14-71	ADDED SHT 5			
TY	9000	6-14-71	ADDED SHT 5			
TZ	9000	6-14-71	ADDED SHT 5			
UA	9000	6-14-71	ADDED SHT 5			
UB	9000	6-14-71	ADDED SHT 5			
UC	9000	6-14-71	ADDED SHT 5			
UD	9000	6-14-71	ADDED SHT 5			
UE	9000	6-14-71	ADDED SHT 5			
UF	9000	6-14-71	ADDED SHT 5			
UG	9000	6-14-71	ADDED SHT 5			
UH	9000	6-14-71	ADDED SHT 5			
UJ	9000	6-14-71	ADDED SHT 5			
UK	9000	6-14-71	ADDED SHT 5			
UL	9000	6-14-71	ADDED SHT 5			
UM	9000	6-14-71	ADDED SHT 5			
UN	9000	6-14-71	ADDED SHT 5			
UP	9000	6-14-71	ADDED SHT 5			
UR	9000	6-14-71	ADDED SHT 5			
US	9000	6-14-71	ADDED SHT 5			
UT	9000	6-14-71	ADDED SHT 5			
UU	9000	6-14-71	ADDED SHT 5			
UV	9000	6-14-71	ADDED SHT 5			
UW	9000	6-14-71	ADDED SHT 5			
UX	9000	6-14-71	ADDED SHT 5			
UY	9000	6-14-71	ADDED SHT 5			
UZ	9000	6-14-71	ADDED SHT 5			
VA	9000	6-14-71	ADDED SHT 5			
VB	9000	6-14-71	ADDED SHT 5			
VC	9000	6-14-71	ADDED SHT 5			
VD	9000	6-14-71	ADDED SHT 5			
VE	9000	6-14-71	ADDED SHT 5			
VF	9000	6-14-71	ADDED SHT 5			
VG	9000	6-14-71	ADDED SHT 5			
VH	9000	6-14-71	ADDED SHT 5			
VJ	9000	6-14-71	ADDED SHT 5			
VK	9000	6-14-71	ADDED SHT 5			
VL	9000	6-14-71	ADDED SHT 5			
VM	9000	6-14-71	ADDED SHT 5			
VN	9000	6-14-71	ADDED SHT 5			
VP	9000	6-14-71	ADDED SHT 5			
VR	9000	6-14-71	ADDED SHT 5			
VS	9000	6-14-71	ADDED SHT 5			
VT	9000	6-14-71	ADDED SHT 5			
VU	9000	6-14-71	ADDED SHT 5			
VV	9000	6-14-71	ADDED SHT 5			
VW	9000	6-14-71	ADDED SHT 5			
VX	9000	6-14-71	ADDED SHT 5			
VY	9000	6-14-71	ADDED SHT 5			
VZ	9000	6-14-71	ADDED SHT 5			
WA	9000	6-14-71	ADDED SHT 5			
WB	9000	6-14-71	ADDED SHT 5			
WC	9000	6-14-71	ADDED SHT 5			
WD	9000	6-14-71	ADDED SHT 5			
WE	9000	6-14-71	ADDED SHT 5			
WF	9000	6-14-

SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPRD
			SEE SHEET			

REFERENCE

(GRN) J2

15 +26V
1 NC
2 +12V R1 25K, R2 27K
3 +12V R3 25K, R4 2.7K
4 +12V R5 25K, R6 2.7K
6 +12V R9 25K, R10 2.7K
7 +12V R11 25K, R12 2.7K
8 +12V R13 25K, R14 2.7K
9 +12V R15 25K, R16 2.7K
10 +12V R17 25K, R18 2.7K
5 +12V R7 25K, R8 2.7K
14 I LED
11 NC
13 TEMP
12 OV

Z1 74C14 / Z2 4050:
- 3 4 DATA 1 — 3 2
- 5 6 DATA 2 — 7 6
- 13 12 DATA 3 — 14 15
- 9 8 DATA 4 — 11 12
- Z5 74C14: 5 6 DATA 5 — Z2 4050: 9 10
- Z5 74C14: 13 12 DATA 6 — Z9 4050: 3 2
- Z5 74C14: 9 8 DATA 7 — Z9 4050: 7 6
- Z5 74C14: 11 10 DATA 8 — Z9 4050: 5 4
- Z1 74C14: 11 10 SPKT — Z2 4050: 5 4 SPKT

+12V R23 6.81K ±1%, R22 5.16K ±1%, R21 12.1K ±1%, R20 196Ω ±1%
Q1 TPI9
OV OV OV OV

+5V RG7 2.2K

Z6 7475: 2 D1 Q1 16; 3 D2 Q2 15; 6 D3 Q3 10; 7 D4 Q4 9; 4 13
STROBE 1

Z7 7475: 2 D1 Q1 16; 3 D2 Q2 15; 6 D3 Q3 10; 7 D4 Q4 9; 4 13
STROBE 2

86 Z3: 1 2 3 — CHANNEL 1 OUT
86 Z3: 13 12 11 — CHANNEL 2 OUT
86 Z3: 4 5 6 — CHANNEL 3 OUT
86 Z3: 10 9 8 — CHANNEL 4 OUT
86 Z4: 1 2 3 — CHANNEL 5 OUT
86 Z4: 13 12 11 — CHANNEL 6 OUT
86 Z4: 4 5 6 — CHANNEL 7 OUT
86 Z4: 10 9 8 — CHANNEL 8 OUT
86 Z25: 2 1 3 — DATRDY OUT

J1
1 CHANNEL 1 OUT
2 CHANNEL 2 OUT
3 CHANNEL 3 OUT
4 CHANNEL 4 OUT
5 CHANNEL 5 OUT
6 CHANNEL 6 OUT
7 CHANNEL 7 OUT
8 CHANNEL 8 OUT
9 DATRDY OUT
10 MODE SELECT
23 +5V
25 CHASSIS GROUND
11 12 13 24 OV
19 +12V
22 -12V

DATRDY
MODE SELECT
CA9 .001MF, RG6 10Ω, +5V, R85 10K
OV
+12V
-12V

Figure 8-2
Sheet 2 of 5

Schematic Reader Card 114321-0
8-7/8-8

- NOTICE -
THIS DRAWING IS THE PROPERTY OF REMEX, A [illegible] CORPORATION AND EMBODIES A CONFIDENTIAL AND PROPRIETARY DESIGN IN WHICH REMEX RETAINS ALL PATENT AND OTHER RIGHTS INCLUDING EXCLUSIVE RIGHT OF USE, MANUFACTURE AND SALE. IT IS SUBMITTED UNDER A CONFIDENTIAL RELATIONSHIP FOR A SPECIFIC PURPOSE, AND THE RECIPIENT AGREES BY ACCEPTING THIS DRAWING NOT TO SUPPLY OR DISCLOSE ANY INFORMATION REGARDING IT TO ANY UNAUTHORIZED PERSON.

REMEX [illegible]
DWG No. [illegible] REV B
DR [illegible] CHK [illegible] APP [illegible] SHEET 2 OF 5

FORM NO. ED33/612

SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPRD
			SEE SHEET 1			

PART OF J4

S3 DLS 3 — +5V RG8 1K

5 — +5V RG9 1K

DRS 4 0V

PART OF J1

DLS

DRS

TP4

DL 17 — Z10 5,4 — LS132 Z11 2,1,3

WL 21 — Z36 3,2,2 — LS00 Z13 1,2,3 — Z8 3,4

WR 20 — Z36 5,4,2 — LS00 Z12 1,2,3 — Z8 1,2

TP5

DR 16 — Z10 3,2 — LS132 Z11 4,5,6

LS132 Z11 12,13,11 — LS00 Z18 1,2,3 — LS00 Z18 5,4,6 — DCCW — CW LEFT

LS132 Z11 10,9,8 — LS00 Z18 12,13,11 — CW RIGHT

LS00 Z18 10,9,8 — DCCW — LS00 Z22 4,5,6 — DRV

LS00 Z22 1,2,3 — DRVG

REV/LK
REVERSE DELAY

A TO B JUMPER ON -001 & -003 ASSY ONLY

-002 & -004 ASSY ONLY

+26V

R33 4.7K

R32 1K — Q2 MPSA06 — 0V

E.O.T.

Q3 (1090)

R34 35Ω 10W — A — B

DAMPING PULSE

LS03 Z27 5,4,6 — +5V R43 330Ω — Q4 (1100)

+5V R31 1K — LS03 Z27 2,1,3

LS03 Z27 12,13,11 — +5V R46 330Ω — Q5 (1100)

LS03 Z27 9,10,8 — +5V R52 330Ω — Q6 (1100)

CR3 (IN4003)

CR4 (IN4003)

CR5 (IN4003)

0V

(YEL) J5

REFERENCE

4 (YEL)
5 (GRN OR BLK)
6 (BLU)

1 (BRN)
2 (RED)
3 (ORN)

M1 (STEP MOTOR) — Ø1 — Ø2 — Ø3

LS86 Z29 5,4,6

LS86 Z27 13,12,11 — LS08 Z29 5,4,6

LS86 Z23 10,9,8 — LS08 Z29 10,9,8

+5V R71 8.2K

C61 100PF 200V

560ns ± 110ns

LS123 Z26 14,15,13 — NC

LS123 Z26 1,2,4

+5V R44 1K — C22 .01 μF — 0V

VPa

LS08 Z29 2,1,3

MOTOR CLOCK TP10

LS74 Z28 12,9 — LS74 Z28 11,8

LS74 Z28 2,5 — LS74 Z28 3,6

LS00 Z22 12,13,11

R50 47Ω — C34 .001 μF 200V — 0V

MOTOR CLOCK PULSE

REVERSE CLOCK

Figure 8-2 Schematic Reader Card 114322-001
sheet 3 of 5 8-9/8-10

– NOTICE –
THIS DRAWING IS THE PROPERTY OF REMEX, A DIVISION OF EX-CELL-O CORPORATION AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN IN WHICH REMEX RETAINS ALL PATENT AND OTHER RIGHTS INCLUDING EXCLUSIVE RIGHT OF USE, MANUFACTURE AND SALE. IT IS FURNISHED UNDER A CONFIDENTIAL RELATIONSHIP FOR A SPECIFIC PURPOSE AND THE RECIPIENT AGREES BY ACCEPTING THIS DRAWING, NOT TO SUPPLY OR DISCLOSE ANY INFORMATION REGARDING IT TO ANY UNAUTHORIZED PERSON.

REMEX — 1733 ALTON STREET, IRVINE CALIF 92714 — DWG. No. 114322-001 — REV. G

DR. — CHK. — APP. — SHEET 3 OF 5

FORM NO. LD433-912

SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPR'D
			SEE SHEET 1			

MOTOR CLOCK PULSE

DRV

DLS

DRS

+5V R47 1K

LS00 LS08 LS00 LS08 LS00

+5V R49 27K

C31 33 µF 10V ±16ms

±150ms

LS123 LS221 LS123

VPa

0V

TP1 SPKT

Z8 04

+5V R70 20K 45ms ±10ms

C50 3.3µF 15V

+5V R42 7.32K ±1% C20 .15µF 770µSec ±82µSec

+5V R43 22K 150µS ±50µS C21 .01 µF

TP7 DELAYED SPROCKET PULSE

+5V R25 8.2K ±10ms C5 100PF 200V 560ms

MOTOR CLOCK PULSE

REVERSE CLOCK

REVERSE DELAY

REV / LK

PART OF J1

EXT INH

+5V R35 1K

LS08

+5V CR1 (IN4003) CR2 (IN276) R41 22Ω C19 .01µF

INH

R40 22Ω C57 10µF 25V

WIND ENABLE

+5V R28 8.2K 550µs ±60µs C9 .1µF

+5V R29 25K 1/2W ±20% R30 22K CW 2.9ms ±.4ms C11 .1µF

+5V R26 10K R24 25K 1/2W ±20% C7 .036µF 770µs ±70µs

+5V R48 47K ±150ms C29 33µF 10V 550ms

R36 47Ω C17 .001µF 200V

PART OF J1

Z8 04

SYS RDY

TP8 CP

TP9

E.O.T.

DAMPING PULSE

C54 .01µF

R39 47Ω C18 .01µF

DRVG

TPG DAT RDY

STROBE 1

STROBE 2

DAT RDY

REFERENCE -0018-002 ASSYS ONLY

PART OF J4

LDS

SPL

LOOP LOAD SPOOL (SHOWN IN LOAD POSITION)

+5V R37 2.2K

SPL INH

Figure 8-2
sheet 4 of 5

Schematic Reader Card 114322-00
8-11/8-12

- NOTICE -
THIS DRAWING IS THE PROPERTY OF REMEX A DIVISION OF LEAR SIEGLER CORPORATION AND EMBODIES A CONFIDENTIAL PROPRIETARY DESIGN IN WHICH REMEX HAS ALL PATENT AND OTHER RIGHTS INCLUDING EXCLUSIVE RIGHT OF USE. SUBMISSION OF THIS DRAWING IT IS SUBMITTED UNDER A CONFIDENTIAL RELATIONSHIP FOR A SPECIFIC PURPOSE AND THE RECIPIENT AGREES, BY ACCEPTING THIS DRAWING, NOT TO SUPPLY OR DISCLOSE ANY PART OF IT OR ANY INFORMATION REGARDING IT TO ANY UNAUTHORIZED PERSON

REMEX 733 ALTON STREET IRVINE CALIF 92714 A DIVISION OF LEAR SIEGLER, INC.

DWG No. 114322-001 REV. G

DR. CHK. APP. SHEET 4 OF 5

FORM NO. ED623/812 R

SYM	ECO	EFFECT.	REVISIONS	BY	DATE	APPRD
			SEE SHEET 1			

REFERENCE
RIGHT ARM
(BLU) J3
CW
OV
-001 & -002 ASSY ONLY
R54 1K
+12V
C36 .1 µF
C37 .0022µF 200V
R56 270K
R57 2 MEG
R58 1K
R59 1K
Z31
R53 4.7K
R55 4.7K
-12V
C38 .001µF 200V
C39 .001 µF 200V
RG1 820Ω 1/2 W
RG2 820Ω 1/2 W
RG3 330Ω
RG0 330Ω
+26V
-28V
Q8
Q9
Q12
Q13
RG5 100Ω
RG4 1K
C40 330PF 200V
REFERENCE
LEFT ARM
(BLU) J6
C63 .1MF
C64 .0022µF 200V
R75 270K
R76 2 MEG
R77 1K
R78 1K
Z32
C48+ 100µF 25V
R73 4.7K
R74 4.7K
R72 2.2K
SPLINH
Q7
C65 .001µF 200V
C66 .001 µF 200V
R80 820Ω 1/2 W
R81 820Ω 1/2 W
R82 330Ω
R79 330Ω
Q10
Q11
Q14
Q15
R84 100Ω
R83 1K
C67 330 PF 200 V
(RED) J7
REFERENCE
L3 50MHZ
L1 50MHZ
L2 50MHZ
L4 50MHZ
M
RIGHT MOTOR
LEFT MOTOR
R101
R102
OVM
REFERENCE
POWER SWITCH
S101
S104
T101
BR101
115V
A
B
C101
C102
(WHT) J8
TP16
TP17
TP2
TP3
TP18
TP11
+26V
+12V
+5V
-12V
-28V
IN
OUT
C
Z33 7812
Z34 7805
Z35 7912
C13 1 µF 50V
C14 1 µF 50V
.01µF 25V C1, 3
C16 1 µF 50V
C15 1 µF 50V
.01 µF 25V
C50 .1 µF 100V
C24 1 µF 50V
C23 1 µF 50V
C2, 4, 6, 8, 10, 12, 25, 26, 27, 28, 30, 32, 33, 35, 41, 42 AND 43, 44, 45, 46, 47, 51, 52, 53, 55, 56, 58, 60 AND 62.

Figure 8-2
sheet 5 of 5

Schematic Reader Card 114321-001
8-13/8-14

– NOTICE –
THIS DRAWING IS THE PROPERTY OF REMEX, A DIST. OF EY CYCLE CORPORATION AND THISDOCILE A CONFIDENTIAL PROPRIETARY DESIGN IN WHICH ALBLE RETAINS ALL PATENT AND OTHER RIGHTS INCLUDING EXCLUSIVE RIGHT OF USE, MANUFACTURE AND SALE. IT IS SUBMITTED UNDER A CONFIDENTIAL RELATIONSHIP FOR A SPECIFIC PURPOSE AND THE RECIPIENT AGREES BY ACCEPTING THIS DRAWING, NOT TO SUPPLY OR DISCLOSE ANY INFORMATION REGARDING IT TO ANY UNAUTHORIZED PERSON

REMEX 1733 ALTON STREET IRVINE CALIF 92714
DWG. No. 114321-001 REV. G
DR. CHK. APP. SHEET 5 OF 5

FORM NO. ED-13/912

800
553-5981

This is the *toll free* number* to call when you need assistance in ordering repair parts or fittings . . . fast! You will be connected with a person who can assist in determining the parts or fittings you require and who can direct you to our local authorized distributor's inventories of these items.

If you need information about shipping dates, routing and delivery, the person who expedites your order will have it available.

Should you choose to send your orders for parts or fittings by mail, please direct them to: Cherry-Burrell, Repair Parts Department, 2400 Sixth Street SW, PO Box 3000, Cedar Rapids, IA 52406 or to your nearest Cherry-Burrell authorized distributor.

*Iowa Customers call 319/399-3200 COLLECT.

CHERRY-BURRELL
AMCA INTERNATIONAL

CHERRY-BURRELL CORPORATION
2400 SIXTH STREET SW
PO BOX 3000
CEDAR RAPIDS, IA 52406, USA